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ZAMONAVIY DUNYODA AMALIY FANLAR:
MUAMMOLAR VA YECHIMLAR

RESPUBLIKA ILMIY-AMALIY KONFERENSIYASI

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«Zamonaviy dunyoda amaliy fanlar: Muammolar va yechimlar» nomli № 01-sonli ilmiy, masofaviy, onlayn konferensiyasi

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KONFERENSIYA TO’PLAMI ZENODO, OPEN AIRE, OPEN ACCESS VA INTERNET ARCHIVE BAZALARIDA INDEKSLANADI. KONFERENSIYA TO’PLAMIGA DOI RAQAMI BERILADI. KONFERENSIYA TO’PLAMIGA QUYIDAGI YO‘NALISHLAR BO‘YICHA MAQOLALAR QABUL QILADI:

1. **AXBOROT TEXNOLOGIYALARI**
2. **MATEMATIKA (TURLARI BO’YICHA)**
3. **FIZIKA (TURLARI BO’YICHA)**
4. **TEXNIKA FANLARI**

ESLATMA! KONFERENSIYA MATERIALLARI TO‘PLAMIGA KIRITILGAN MAQOLALARDAGI RAQAMLAR, MA’LUMOTLAR HAQQONIYLIGIGA VA KELTIRILGAN IQTIBOSLAR TO‘G‘RILIGIGA MUALLIFLAR SHAXSAN JAVOBGARDIRLAR.

MUNDARIJA

IMPROVE ENERGY CONTROL IN BUILDINGS

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Annotation: the aim of the study directed to develop the directions to improve energy audits in building that will affect the efficiency of enterprises and allowed to earn more profit. Methodology – In this article the methods of descriptive and comparison analysis of development of education system, based on empirical data, synthesis, induction, and deduction were used.

Key words: Findings ,energy audit, methodology, businesses, collection, production, works, services

Originality/value – energy audit of industrial enterprises or buildings for other purposes is carried out to give a realistic assessment of the level of consumption efficiency, identify existing reserves, development of organizational and technical decisions directed relation between necessary for the implementation of these measures of investment and potential savings, as well as the forecast of savings in financial and physical expression.

Findings – the author suggested the definition of an energy audit, energy audit provides a methodology, developed energopasprot of enterprise. Energy audit of buildings more sophisticated way, using special measuring sensors and instruments, allows to obtain a more detailed picture and to provide additional data records which will more accurately choose the necessary measures, as well as improve the quality and efficiency.

The energy crisis in the present day world has led us to the design of new energy efficient buildings. However the existing buildings consume a lot of conventional energy and minimizing them will help us to conserve them for future. Moreover it would help us to meet the Energy Efficiency standards.

The capital costs for this conversion would be very high, but lower energy bills over a long period of time would offset them and helps to achieve significant profits for the industry as well as the environment. Energy audit involves the systematic collection and analysis of energy data from a particular facility for implementing energy conservation measures.

An energy audit establishes both where and how energy is being used, and the potential for energy savings. It includes a walk-through survey, a review of energy using systems, analysis of energy use and the preparation of an energy budget, and provides a baseline from which energy consumption can be compared over time. An audit can be conducted by an employee of the organization who has appropriate expertise, or by a specialist energy-auditing firm. An energy audit report also includes recommendations for actions, which will result in energy and cost savings. It should also indicate the costs and savings for each recommended action, and a priority order for implementation.

An energy audit is a comprehensive review of your dwelling, its systems and its occupants performed by a qualified energy auditor who determines how energy is being used. The auditor provides suggestions for lifestyle changes and written recommendations for the most cost-effective energy efficiency measures that will save energy and money while improving comfort and ensuring safety. The most important consideration when deciding on

an audit is the auditor's training, certification and experience. The term "energy audit" appeared **in the early 1990.** And its popularization has been associated with the development of such international programs as TACIS and USAID. Energy audit an analysis of the enterprise to determine the energy efficiency of production, the search options to reduce energy costs and their feasibility.

In the design of industrial buildings, professional planning with the latest lighting technology can achieve significant energy savings. The same applies to portfolio properties where renewing the lighting system can save up to 75 % in energy. In general, lighting accounts for up to 80% of the power consumption in logistics centers. Since the energy costs devour around 70 % of the total costs of a lighting system, energy-efficient lighting solutions can provide the greatest levels of saving. Switching to energy efficient lighting is the most frequently implemented method of saving in the area of technical building equipment. The amortization times are in the order of three to four years. In many cases they can be reduced to less than two years, depending on the cost of electricity and the regional device and installation costs.

He purpose of energy audit work is to analyze the energy use of the premises being audited in order to find out the potential for energy savings and to present proposals savings measures for calculating profitability. Energy audits also help clarify the possibilities for the use of renewable energy sources. In addition to the energy savings potential, the audit report presents an estimate of the impact of the proposed measures on CO2 **emissions.** In order to carry out energy audits for the service, industrial and energy sectors clients can apply **for support from the Ministry of Employment and the Economy.** An audit model has been developed for the energy audits of apartment blocks. Support for carrying out energy audits of residential premises can be applied for from the Ministry of the Environment's residential premises energy assistance support. Conveyor chains' energy audit involves a comprehensive inspection of commercial transport conveyor chains. The audit especially benefits the procurement industry of transport services, the business sector and municipalities. From the perspective of conveyor chains, energy audits can intensify energy use, cut costs and reduce CO2 **emissions.** In addition, an energy audit provides the tools for improving the logistics of transport services **provided by businesses.** The energy audit of conveyor chains focuses on reducing the energy consumption and CO2 emissions of the transport of raw materials and products by industry, commerce and municipalities.

An energy audit is a collection and processing of information about energy resource use in order to obtain exact information on the volume of energy resources consumed, energy efficiency indices, and detection of possibilities for energy saving and enhanced energy efficiency with showing the obtained results in the energy passport.

The major result of an energy audit should be the program for implementation of optimal energy maintenance of the object in accordance with the requirements of the Federal Law "Concerning Energy Saving and Enhanced Energy Efficiency."

Energy audit (energy inspection) collection and processing of information about the object in order to obtain reliable information on the amount of used heat-and-power resources (fer), size and character of their losses on energy efficiency, to identify opportunities for energy conservation and energy efficiency with the reflection of the received results in the energy passport.

Energy saving implementation of organizational, legal, technical, technological, economic and other measures aimed at reducing the amount of used energy resources while maintaining the useful effect from their use (the volume of production, works, services).

The global economy is increasingly showing its dependence on energy resources [2, p. 2661]. New constructed and (or) reconstructed (including old design documents following the entry into force of stories on energy audit) buildings, structures, constructions except for temporary structures (service life of less than 2 years), auxiliary buildings, buildings of less than 50 and so forth., must meet the requirements of energy efficiency.

Indeed, it is not permitted commissioning (including preparation of project documentation) of buildings, structures, constructed, reconstructed, recently overhauled and do not comply with the energy efficiency requirements of equipment and metering devices used in their energy resources. The last requirement applies to all owners of buildings, structures and facilities put into operation today.

These activities are carried out by the developer selection of optimal architectural, functional and technological, structural and technical solutions and their proper implementation in the implementation of construction, reconstruction and overhaul.

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ENERGY AUDIT OF BUILDINGS

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Annotation: Energy efficiency enables getting energy passport which is one of the conditions for a variety of benefits that will be applied in the future. Modern facilities under construction are governed by this rule. As far as measures are concerned, energy efficiency implies measures applied for the purpose of reducing energy consumption. Whether we talk about technical or non-technical measures, or changes in behaviour, all measures imply the same or even higher degree of achieved comfort and standard.

Key words: . Methods,energy audit, methodology, businesses, collection, production, professional consultant.

Energy consumption at the beginning of the twenty first century shows a steady growth trend in all regions and countries of the world. For thirty-five years, energy consumption has increased by more than 2 times. Only in the last 10 years it has increased by 11%

Today, the development of any country can not go without and use, have become the world heritage, advanced technology

GDP and labor productivity in the sectors of Kazakhstan's economy lags behind some industrialized countries more than 7-10 times. In Kazakhstan, the production of one dollar of GDP spent almost 2.8 kilowatthours, in countries such as Britain, Germany, Italy and Japan, the figure is 0,22-0,3 in the United States, France, Turkey, Koree0.4-0.6, Canada and China 0.8-1.2 kilowatt-hours [10, p. 66].

According to some researchers, there are many factors that determine the importance and usefulness of energy audits, explaining why energy users to trust its results .A particularly important aspect of the audit is an additional benefit from the fact that a study carried out by a qualified technician, not a random employee of the company. Most often, the confidence of the leaders of the recommendations are a professional consultant, not the Staff Council.

Experts identify two distinct types of audit. When conducting an energy audit of a simple type is taken as a basis for the actual energy consumption over a certain period of time. For this method does not require a special test equipment and instruments, all relevant information can be obtained from the bill sent by the inspection agency to pay for energy consumed. This type of energy audit makes it impossible to create a complete picture of the energy balance of a particular building, it is its major shortcoming.

Stages of the energy audit.

Preproduction: This energy audit carried out at the beginning of operation or immediately before the commissioning of the equipment to determine the primary characteristics of energy efficiency, as well as regulatory, design and passport indices. In addition, the pre-operational audit conducted at the change of regime and the operating conditions, major repairs or replacement of the generating and energy consuming equipment (more than 5% of consumption-type ER), which is part of the power system. Primary: inspection of objects (consumers ER) for the first time or when the last power plant surveys conducted over 5 years ago. Priority: This energy audit conducted to compare the current figures with those of energy efficiency indicators that were identified during the previous survey, make changes in the

energy performance certificate, pass a voluntary certification. The next audit goes as planned no more than 1 times in two years, not less than 1 time within the statutory period of five years.

Extraordinary: This energy audit need to hold it there with the growth of more than 25% of needs identified in the course of a routine inspection; when switching to another type of fuel consumption; in monitoring and evaluation components, announced the approval of tariffs and technical losses; when applying for benefits for . Also extraordinary examination is carried out in cases where the consumer showed an increase in consumption, the fall of the effectiveness of energy saving, increased emissions and so forth.

In terms of the work carried out energy audits are divided into. Quick Survey: identifies areas where irrational use, improve energy efficiency businesses by identifying priority areas to reduce the costs allocated to the necessary energy. Such an energy audit is usually conducted on an abbreviated program, using a minimum of equipment (or at all without it), and the evaluation can be carried out both in all types and only one of them (electricity, gaseous and liquid fuels, etc.). There may also be assessed the effectiveness of the use of secondary, the operation of a single unit or a group of them and so forth.

Full instrumental examination: it is necessary to analyze the consumption of the current period, as well as the modes of operation of the equipment; identify the reasons why the power supply is accompanied by excessive losses.

Local survey: energy audit of enterprises, implies a certain energy flows, technological installations and processes in individual departments. The purpose of the survey identify at selected sites problems associated with energy consumption and development needed to address them recommendations.

Under the law provides for an energy audit in the survey of office buildings, public and residential (including apartment buildings), as well as industrial facilities.

This energy audits of buildings and structures is mandatory in cases of:

putting into operation after major repair, reconstruction or completion;

surveys to be supervised by a public authority building control buildings.

Given that these examinations are conducted in order to implement energy-saving technologies into practice, thereby improving the energy efficiency infrastructure and reduce costs, the legislation establishes mandatory for its passage of the following organizations and businesses:

public authorities and local governments;

organization of the municipality;

companies with regulated activities;

organizations realize the extraction, processing, production, transportation of oil and oil products, coal, electricity, gas and water;

organizations, the total cost of which energy consumption is above 10 mln. tenge / year;

organizations that receive funding or local budget. Energy survey conducted voluntarily on such objects as:

religious buildings and structures, as well as objects of cultural heritage;

temporary buildings with a useful life of less than 2 years;

supporting facilities.

The measures to improve the accounting and control of expenses of energy enterprises. Methods of energy audit can include the following components:

Organizations to be energy audits. Energy audit of the following organizations:

public authorities, local governments, rights of legal entities;

organizations with the participation of the state or municipality;

organizations engaged in regulated activities;

organizations engaged in the production and (or) transportation of water, natural gas, thermal energy, electricity, natural gas, oil, coal, production of petroleum, natural gas processing, oil, transportation of oil;

the organization, the total cost of which the consumption of natural gas, diesel and other fuel, oil, heat, coal, electricity exceeds ten million rubles per calendar year;

organizations conducting activities in the field of energy conservation and energy efficiency, financed wholly or in part at the expense of the federal budget, regional budgets.

Organizations that have the right to conduct energy audits. Energy audit a specific kind of work that can perform specialized organization with trained professionals, appropriate methods, instrument park and experience in the energy

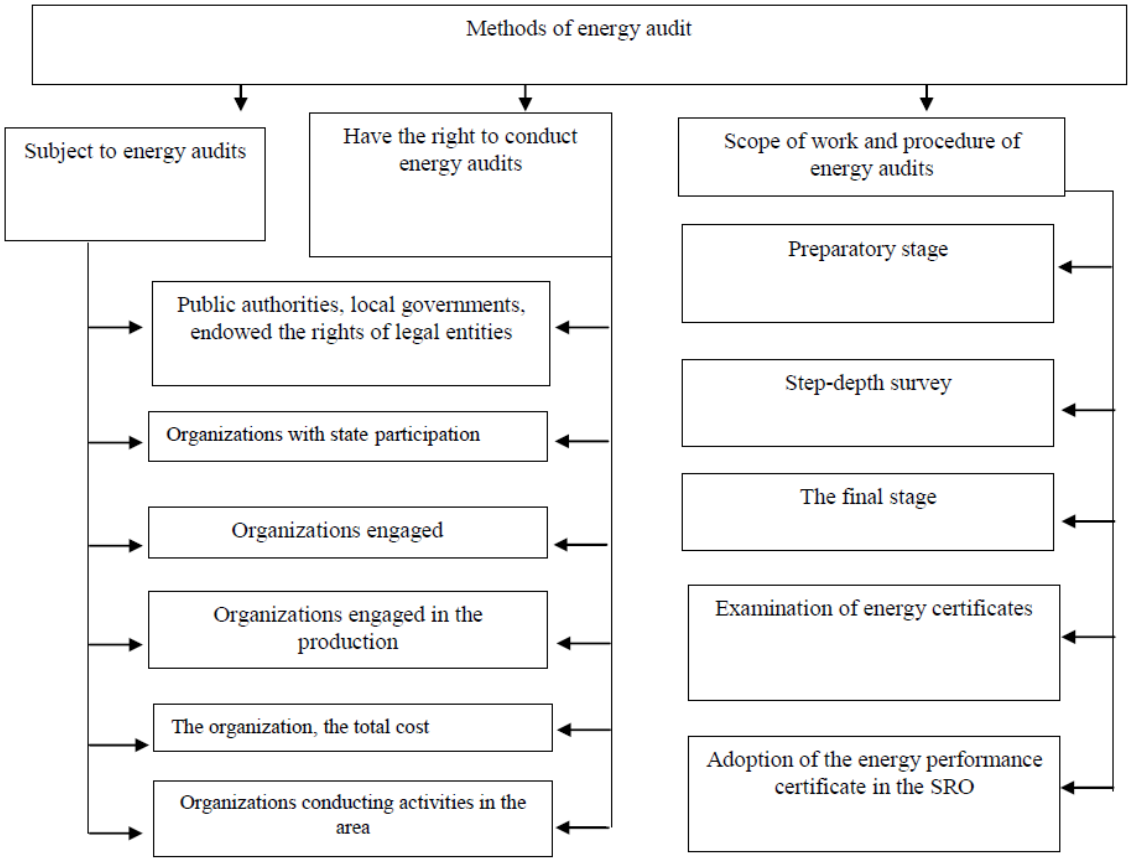

Figure 1 – Method of Energy Survey

igure 1 – Method of Energy Survey

Scope of work and the procedure for energy

In conducting energy audits conducted analysis of the state of power supply systems, heating, water supply, maintenance of the park enterprise (object), assessment systems and tools (instruments) excluding energy and compliance with statutory requirements, the identification of unreasonable losses, assessment of the state system of regulation of energy

consumption and energy use, check the energy balances of the enterprise (facility), the calculation of specific energy consumption for manufactured products (or types of works), assessment of the feasibility of basic energy-saving measures to be implemented now, the formation of energy passport of the enterprise, in the scope of work includes:

Assessment of the volume of work. Collect baseline data.
Harmonization of technical specifications and
Conclusion of the agreement to conduct energy
Step-depth
Ordering of the source data and analysis of project and technical documentation.
Implementation of the survey instrument and drawing up a balance of all types.
An in-depth examination of the sectors with the largest energy infrastructure
Development of the program of energy saving measures to small and medium-payback period by sectors with the highest losses.
Development of the program of energy saving measures on the project as a
Preparation of the energy performance certificate and the technical
Approval of the technical report by the
The final
Examination of energy
Approval of the energy performance certificate in the
Develop Energy Performance Company. In the energy passport is recognized:
Brief description of the construction
Fundamentals of energy efficient
Technical equipment and production
Modern architecture and energy
Energy efficient refurbishment of residential buildings: benefits for tenants and housing management of multi-storey buildings on the example of (a round table with representatives of housing enterprises).
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ENERGY-SAVING TECHNOLOGIES IN AUTONOMOUS HEATING SYSTEMS

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Annotation:The given article is devoted to the consideration of the necessity and the possibility of application of innovative energy-saving technologies in autonomous heating systems allowing for the decrease of the detrimental influence of the combustion-generated wastage upon the environment, and for the reduction of expenses on the production of long-burning solid-fuel boilers.

Keywords: Coal, autonomous heating systems, technology, model, Pyrolysis, cleanliness, cyclones.

The article is aimed at a more detailed description of the technical peculiarities of the proposed ergonomic solutions with a view of attracting the attention of ecological engineering specialists and investors to the topicality of the given propositions.

The analysis of the technical components was conducted in terms of the comparison of the traditional means of heating and their innovative counterparts.

According to the results and the conclusions of the research conducted, the application of energysaving technologies in autonomous heating systems is still a topical issue that deserves the attention of contemporary ecologists and engineers.

Coal is the largest source of energy in the contemporary world, being the means of power generation and providing the basis for the production of heat and light on a global scale. At the same time, there is a deeply ingrained public misperception that coal is a dirty fossil fuel and coal-mining industry is an obsolescent branch of industry characteristic of the Machine Age.

Nevertheless, the modern technological progress destroys this myth, providing vivid examples of highly efficient use of coal and systemic solution of ecological issues.

One of these vivid examples is the innovative long-burning solid-fuel boiler with the pyrolized effect (henceforth LSB) for autonomous heating systems which makes it possible to considerably economize the fuel resources, to reduce the ecologically detrimental emissions into the atmosphere, and to decrease the customers' heating expenses [1].

It is widely assumed that the power engineering of the future is connected with renewable resources**.** But it is within the realm of possibility that coal, oil and gas will maintain the dominance if the contemporary technological solutions contribute to the elimination of the carbon dioxide emission.

The LSB technology makes it possible to considerably reduce the emissions of contaminants into the atmosphere**.** This model is based on the principle of upper combustion of the fuel - the coal is burned on the surface, slowly smouldering [2].

The following figure demonstrates the technical peculiarities of the boiler.

Figure 1. Technical features of LSBs

The function ofboiler controlling is performed by the microprocessor and the fan. They regulate the process of combustion and maintain the set temperature indoors through the temperature of the heat carrier. The air enters the combustion chamber from above and enters the combustion zone [2].

Thus, the technology of the long-burning boilers is based on the phenomenon of pyrolysis.

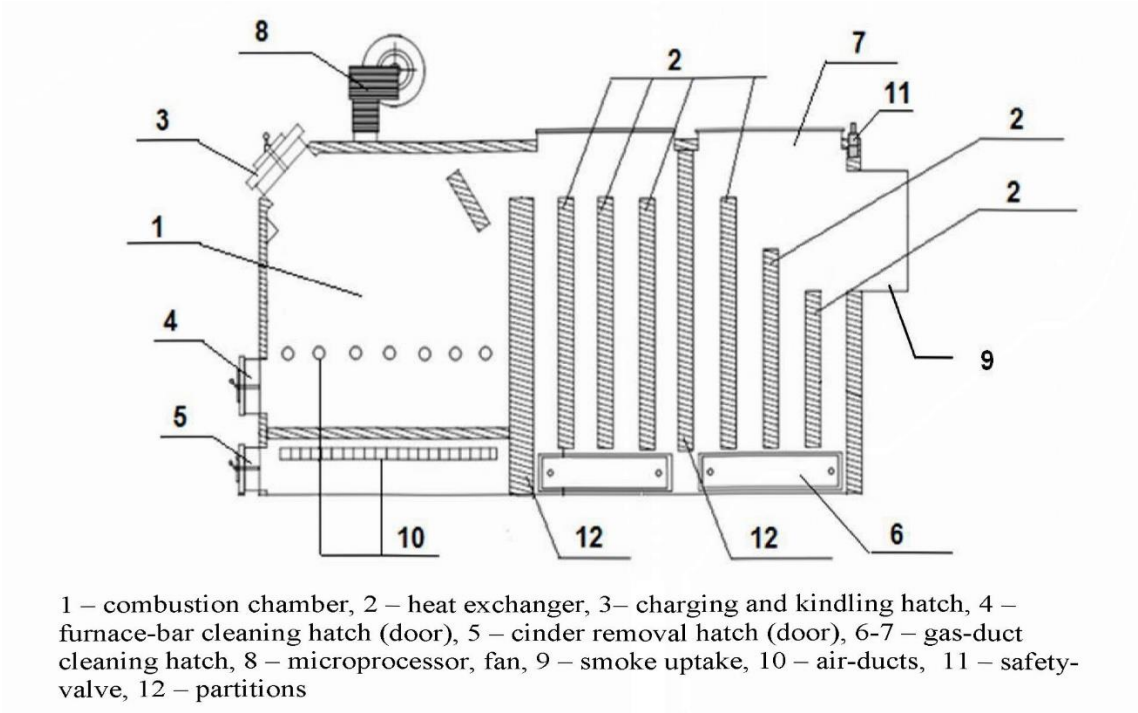
Pyrolysis is the thermal destruction of the source material as such, whilst the pyrolytic reaction represents in itself the destruction of the normal structure of a given material by virtue of high temperatures and through the oxygen blockage.

One of the most common types of this phenomenon is the rapid pyrolysis which is characterized by the high-velocity and oxygenless supply of energy to the source material.

Here are some basic peculiarities of the process of pyrolysis:

The capacity tor the generation of an enclosed and incessant technological process of production.

Relative «cleanliness» of the final products of pyrolysis, achieved due to the absence of the features of resinification.



1 – combustion chamber, 2 – heat exchanger, 3– charging and kindling hatch, 4 – furnace-bar cleaning hatch (door), 5 – cinder removal hatch (door), 6-7 – gas-duct cleaning hatch, 8 – microprocessor, fan, 9 – smoke uptake, 10 – air-ducts, 11 – safety-valve, 12 – partitions

Minimal energy capacity of the given process, as compared to other types of pyrolysis.

The given process is accompanied by the emission of a large amount of heat energy (exothermic reactions surpass the endothermic ones in the course of the process of rapid pyrolysis).

The gaseous product of the pyrolysis of black coal is the so-called pyrolytic gas, which represents the mixture of combustible gases and various chemical compounds.

In many countries pyrolytic gas is currently used as an alternative source of heat energy.

Inside of an LSB, the pyrolytic gas enters the combustion zone and is burned there emitting the heat energy**.** This technological solution increases the coefficient of performance of the boiler.

While this technology is considered to be quite new for us, in some European countries pyrolytic gas became an ordinary fuel a long time ago. Apart from that, pyrolytic gas, as well as coal-tar resin, can be used for the acquisition of various chemical compounds.

Thus, the pyrolytic gas may serve as the means of acquisition of such substances as phenyl hydride and phenol.

The implementation of this innovative technology has the following advantages:

COP over 90%;

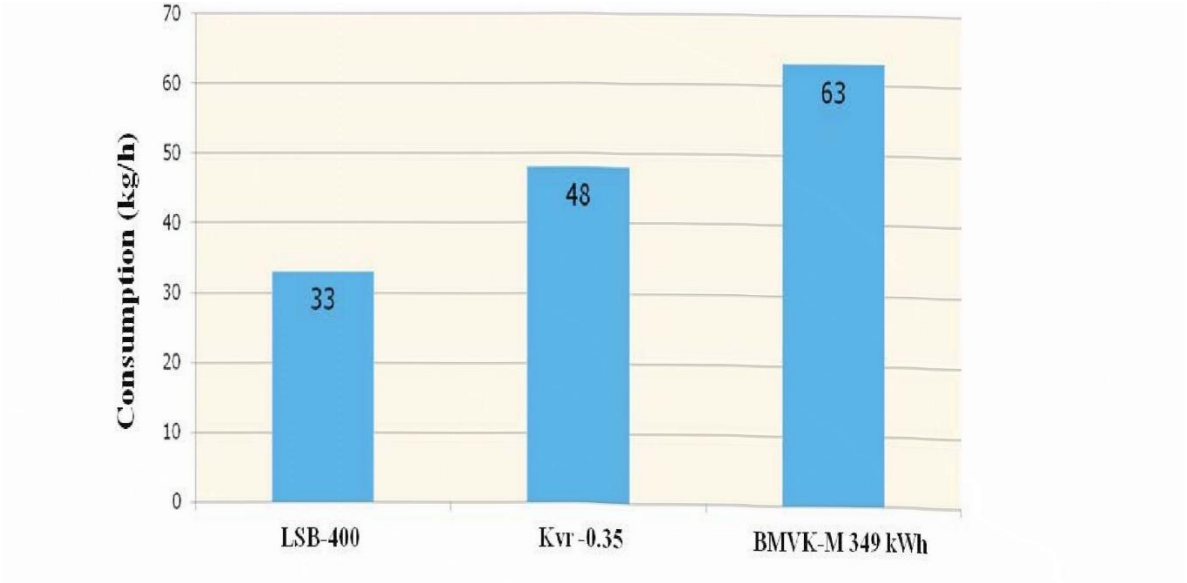
Combustion duration up to 72 hours;

Twofold reduction of heat expenses;

Tenfold reduction of discharges into the atmosphere [2].

Any comparison between LSBs and other boilers is demonstrative in that this technology reduces the coal expenses twice under other equal conditions.

Chart 1. Comparison between LSB coal consumption and that of other popular models.



LSBs effectively perform the functions of such expensive devices as “cyclones” (up to 1.5 million tenge) which are used for the reduction of the amount Ofpollutants emitted into the atmosphere .

Cyclones are the most common means of gas cleaning widely used to separate the dust from the gases and the aspiration air in various branches of industry: ferrous and non-ferrous metallurgy, chemical and oil industry, building material industry, power engineering etc.

Cyclones contribute to the gas purification with the efficiency of 80-95%, cleaning the dust particles in sizes up to 10 mcm.

As has been said, LSBs do not require any additional dust collectors, as compared to other boiler-rooms equipped with dust collectors, whilst the concentration of noxious gases in the LSB emissions is considerably smaller in that the cyclones collect only the solid particles.

According to the recently conducted instrumental measures, the ecological safety of the LSB discharges into the atmosphere has been confirmed.

The main point is that the world’s coal reserves considerably exceed those of other fuels - oil, gas and shale. The world’s coal reserves will last no longer than 250 years, which is twice as much as those of oil, gas, and uranium combined.

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PARAMETRIC DETERMINATION OF CITY HEATING NETWORKS

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Annotation: Heating networks are classified as topological connected objects; therefore performance of networks is largely determined by their structural features. City heating networks were developed with a growth of city and that is why their structure is random.

Keywords: Structure connectivity,graph models, city heating networks, Structural compactness.

Structural analysis allows determining special properties, weak and strong point of these networks. Proposed method of structural analysis was carried out for heating networks of Central Asian states as of 1980-1990.

Created graph models of city heating networks were reflected at the first stage of the analysis by network graph vertex-branches incidence matrixes (A) and independent loops matrix (B).

When performing systems structural analysis it is often necessary to have method allowing determining some structural features of systems and giving them quantitative estimation. Expediency of determining such features is in the fact that the necessity in evaluation of system structure and its elements quality from the position of overall system approach appears already at early design stage. Consider some of them[1].

Structure connectivity. This quantitative characteristic allows detecting presence of breaks, hanging vertexes and ect. in the structure. Complete quantitative determination of directed graph elements connectivity is given by connectivity matrix C = ||⅛■||

Elements of matrix C can be calculated based on matrix a = ∑%=₁A^k

Parameter ε^2 characterizes capacity slackness of the set structure with m edges and n vertexes in achievement of maximal connectivity. This parameter in relative terms is used for comparison of various automated control systems structures.

Structural compactness. Parameter reflecting elements proximity is entered for quantitative estimation of structural compactness. Proximity of two elements i and j will be determined through minimal path length for directed graph (circuits — for undirected) d_{ij}. Then the value Q = ∑f=₁∑ʳj=₁d_{ij} (i≠j) reflects total structural proximity of elements in the system. Relative parameter

Element $c_{ij} = 1$, if $a_{ij}^{\Sigma} \geq 1$; $c_{ij} = 0$, if $a_{ij}^{\Sigma} = 0$. Connectivity of all structure elements for undirected graphs corresponds to fulfillment of the following condition:

$$\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij} \geq n-1; i \neq j$$

The right side of the inequation determines minimum required number of connections in the structure of undirected graph containing n vertexes.

Structure redundancy. Structural parameter reflecting excess of the total number of connections over required minimum is denoted as structure redundancy R.

According to (1) structure redundancy R is determined as:

$$R = \frac{1}{2}\left[\sum_{i=1}^{n}\sum_{j=1}^{n} a_{ij}\right]\frac{1}{n-1} - 1$$

This structural characteristic is used for indirect estimation of economical efficiency and reliability of investigated systems. For systems with maximal redundancy that have "complete graph" structure type, R > 0; for systems with minimal redundancy R=0; for disconnected systems R < 0.

Thus, the system with greater redundancy R is potentially more reliable, however in a number of structural reliability analysis tasks it is reasonable to supplement it with other parameter considering connections non-uniformity, ε^2

Uniform distribution of connections in the structure of undirected graph with t edges and n vertexes is characterized by medium vertex degree $\bar{p}$= 2m/n. Then, having entered deviation concept $p_i - \bar{p}$ where p, — actual degree of given graph vertex t, it is possible to determine quadratic deviation of the set distribution of vertexes degrees from uniform:

$$\varepsilon^2 = \sum_{i=1}^{n}(p_i - \bar{p})^2 = \sum_{i=1}^{n} p_i^2 - 2\bar{p}\sum_{i=1}^{n} p_i + \frac{4m^2}{n} =$$

$$= \sum_{i=1}^{n} p_i^2 - 2 * \frac{2m}{n} * 2m + \frac{4m^2}{n} = \sum_{i=1}^{n} p_i^2 - \frac{4m^2}{n}.$$

Element rank is used when representing system structure in the form of directed graph. This characteristic allows distributing of system elements in the order of their magnitude. Element magnitude is defined here only by number of connections of this element with other ones. Certainly, element rank in such definition doesn't give complete characteristic of element importance in system as in this case accuracy, information and other functional characteristics of element are not considered. However, having characterized element by rank the following plausible assumption can be made: the higher element rank the stronger its connection with other system elements and therefore the more severe effect of its performance quality change. Strict definition of element rank is integrated with certain computing difficulties therefore at this stage of structural analysis approximate way is quite enough. For practical tasks this way gives almost true values of element relative ranks and doesn't require big calculations. Values of elements ranks are quite useful information for distribution of temporary, cost and technical resources for achievement of tasks set at technological networks design stage. Quantitative characteristics entered above may be used when performing comparative evaluation of systems structures topological properties.

Model of city heating networks is presented in table 1. At that due to volume representation of network graph (e.g. Almaty (Fig.1)) column 2 of table 1 contains only generalized model of network graph.

$Q_{\text{отн}} = \frac{Q}{Q_{\text{мин}}} - 1$ is very often used for quantitative estimation of structural compactness

where $Q_{\text{мин}}$=n (n — 1) — minimal value of compactness for system structure of "complete graph" type.

Structural compactness can be also characterized by other characteristic – structure diameter: d = max. Taking into consideration prevailing information character of communications in technological networks it can be stated that value $Q_{\text{отн}}$ as well as d give integral estimation of inertance of information processes in system, and at equal values of ε^2 and R their increase reflects increase of separating communications number thus characterizing reduction of general reliability.

Degree of centralization in structure. Concept of centrality index δ is used for quantitative estimation of centralization degree in structure:

$$\delta = (n-1)(2z_{\text{макс}} - n)\frac{1}{(z_{\text{макс}}(n-2)}$$

where $z_{\text{макс}}$ — maximal value

$$z_i = \frac{Q}{2}\left(\sum_{j=1}^{n} d_{ij}\right)^{-1}, \qquad i = 1,2,\dots,n; \;\; i \neq j.$$

for disconnected structures R < 0; for structures without redundancy (consequential, radial, tree shaped) R = 0; for structures with connections redundancy (ring, «complete graph» type) — R > 0;

structures (consequential, radial, tree shaped) with R = 0 are distinguished by the parameter ε2; radial structure has the greatest nonuniformity of connections;

the structure of "complete graph" type has the greatest elements proximity (parameter Q); the least - consequential; radial and ring structures undistinguishable with regard to parameter d have different Q values;

radial and tree shaped structures having equal or near to equal R, Q, d values are significantly different as per ^{2} and s parameters, that corresponds to physical content as displacement from full centralization in structure results in greater uniformity of elements connections distribution.

Structure processing shows:

HN graph has high centralization degree in Almaty, Leninogorsk, Karaganda. In Uralsk, Arkalyk - low.

HN graph in Almaty (part 1) Almaty (part 2) has greater structure compactness ratio Q (27.6), the lowest in Uralsk (10).

HN graph in Almaty has grater structural redundancy (R=6.23 part 1, R= 4.98 part 2), Karaganda (2.7), the rest cities have structure poorly connected among themselves, that is failure of elements with significant ranks will result in "collapse" of city heating network, that

is in potential break-down. In general this parameter of HN reflects proximity and interaction of elements.

Reviewed structural characteristics were received only based on the information about composition of elements and their connections. Further development of structural parameters construction methodology for solving structural analysis problems can be based on non-structural information by entering numerical functions onto graph. It allows considering other relevant sides of interaction (temporary, reliability, cost and ect.) along with elements composition and interaction directedness when solving structural analysis problems.

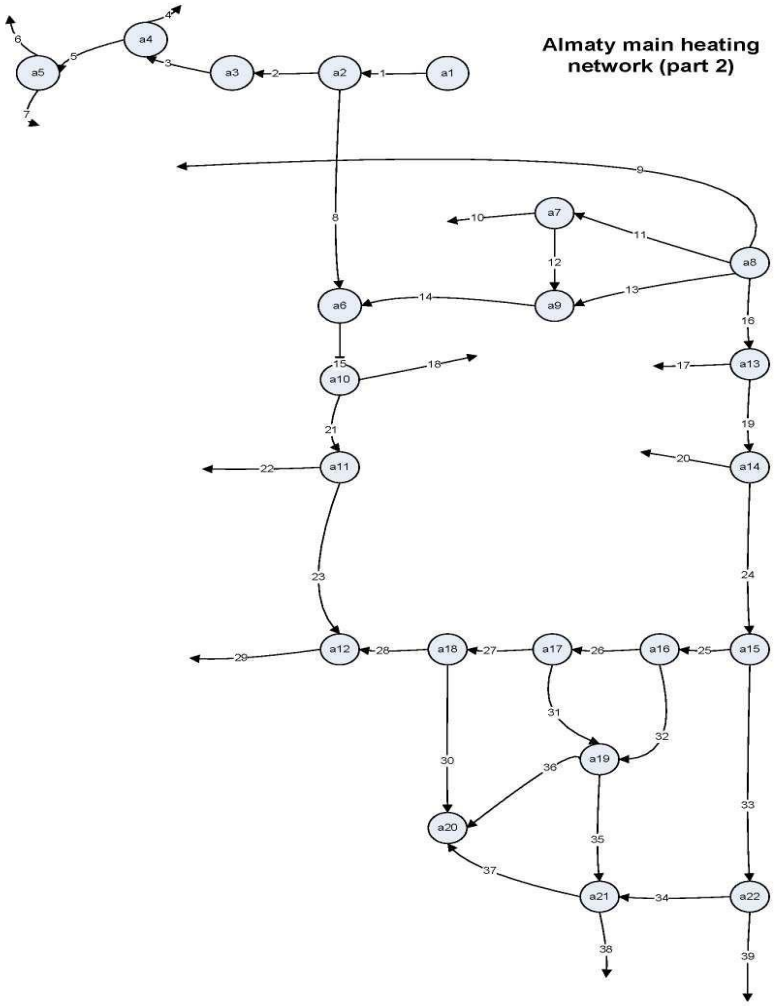

Figure 1

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INFORMATION PROTECTION IN WIRELESS COMMUNICATION SYSTEMS

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ABSTRACT: Wireless networks allow people to connect without a wired connection. This gives you the freedom to navigate and access apps at home, in urban areas, or in remote corners of the world. Wireless networks allow people to receive emails or browse Web pages wherever they want. There are many types of wireless networks, but the most important feature is that the connection is made between computer devices. Computers include personal digital assistants (PDAs), laptops, personal computers, servers, and printers.

KEYWORDS: power, global networks, transmitter, license, telecommunications, data transmission, asynchronous transmission.

INTRODUCTION

1. Wireless network concept and structure
2. Threats to the security of wireless networks
3. Wireless Network Security Protocols

Wireless network concept

Wireless networks allow people to connect without a wired connection. This gives you the freedom to navigate and access apps at home, in urban areas, or in remote corners of the world. Wireless networks allow people to receive emails or browse Web pages wherever they want. There are many types of wireless networks, but the most important feature is that the connection is made between computer devices. Computers include personal digital assistants (PDAs), laptops, personal computers, servers, and printers. Cell phones are not usually included in the list of computer devices, but the latest phones and even headsets have certain computing capabilities and network adapters. In the near future, most electronic devices will be able to connect to wireless networks.

METHODS

The following categories of wireless networks differ depending on the size of the physical area to which the connection is provided:

- Wireless personal-area network (PAN);
- Wireless local-area network (LAN);
- Wireless metropolitan-area network (MAN):
- Wireless Wide-area network (WAN).

Wireless private networks are characterized by a small transmission distance (up to 17 meters) and are used in a small building. The characteristics of such networks are average, and the transfer rate usually does not exceed 2Mb / s.

Such a network, for example, can provide wireless data synchronization on a user's PDA and on his or her PC or laptop. Similarly, a wireless connection with the printer is provided. Loss of clutter in the wiring that connects the computer to external devices is a significant advantage, as it makes it much easier to initially install external devices and then, if necessary, relocate them.

Wireless LANs provide high transmission characteristics inside and outside offices and workplaces. Users of such networks typically use PDAs with processors and large screens

capable of running laptops, personal computers, and applications that require large resources. The employee can use the network services in the conference hall or in other rooms of the building. This allows the employee to perform their duties effectively. Wireless LANs can meet the requirements of all office or home applications at speeds up to 54Mbit / s. In terms of characteristics, components, cost, and performance, such networks are similar to traditional Ethernet-type wired LANs.

Wireless regional networks serve a city-wide area. In most cases, applications require a dedicated connection, and sometimes mobility is required. For example, in a hospital, such a network provides data transmission between the main building and remote clinics. Or an energy company can use such a network on a city-wide basis to provide access to work from different districts. As a result, wireless regional networks aggregate existing network infrastructures or allow mobile users to connect to existing network infrastructures.

Wireless Internet Service Providers (WISP) provide wireless regional networks in cities and rural areas to provide regular wireless connections for home users and companies. Such networks are often more efficient than ordinary wired connections, which have limitations associated with laying wired connections.

Wireless regional network arn characteristics vary. The use of infrared technology in communications ensures data transfer speeds of 100 Gbps and above.

Wireless global networks enable mobile applications to be used across countries or even continents. Based on economic considerations, telecommunications companies are creating a relatively expensive infrastructure for a wireless global network that provides long-distance connectivity for many users. The cost of such a solution is shared among all users, so the subscription fee is not very high.

Users. Because the wireless network serves the user, the user can be seen as an important part of the wireless network. The user starts the process of using the wireless network and completes it himself. Therefore, it is permissible to call it "end user". Typically, a user interacts with a computer device that performs other tasks related to specific applications, in addition to interacting with the wireless network.

Threats to the security of wireless networks

There are many benefits to using wireless technology. While this technology gives users the feeling of being able to move around without losing touch, it provides a great opportunity for network developers to build connections. It also allows you to create many new devices to use the network. But wireless technology poses more threats than conventional wired networks. To create a secure wireless application, you need to identify all the routes through which wireless "attacks" can be transmitted. Unfortunately, apps are never completely secure, but a careful study of the risks of wireless technology can help increase the level of protection in any case. This means analyzing potential threats and building the network in such a way that it is able to prevent attacks and be prepared to defend against non-standard "attacks".

Uncontrolled territory

The main difference between wired and wireless networks is the completely uncontrolled zone between the network endpoints. In a sufficiently wide area of cellular networks, the wireless environment is never controlled. Modern wireless technologies offer a limited set of network space management tools. This allows attackers near wireless structures to carry out attacks that are not possible in a wired world.

Hearing in secret. The most common problem in an open and unmanaged environment, such as wireless networks, is the possibility of anonymous attacks.

Choking. Network failures occur when intentional or unintentional interference exceeds the sender's and receiver's capabilities in the communication channel. As a result, this channel is disabled. An attacker can use a variety of methods.

Refusal to provide services. An attack like DoS (Denial of Service) can completely shut down the network. Throughout the network, including base stations and client terminals, there is such a strong interference that stations cannot communicate with each other. This attack will block all communications within a certain range. It is difficult to prevent or stop a DoS attack on a wireless network. Most wireless networking technologies use unlicensed frequencies, which means there can be interference from multiple electronic devices.

Customer suffocation

Blocking the client station allows the fraudster to place himself in the position of the strangled client (Figure 24.3). It is also used to deny service to a customer in order to prevent them from making the connection. The intent of the very skillful attacks extends the existing connection in order to connect the corrupt human station to the base station.

Block the client station

WLTS protocol. The SSL / TLS-based WLTS protocol is used in WAP (Wireless Application Protocol) devices, such as mobile phones and PDAs. SSL and WLTS differ from each other in traffic levels. SSL relies on TCP to redirect lost packets or transmit non-standard packets. WLTS users using WLTS cannot use TCP to perform their functions because they only use UDP (user Datagram Protocol). The UDP protocol is not intended for connection, so these features should be included in the WLTS.

802.1x protocol. The main function of this protocol is authentication; in some cases, the protocol can be used to set encryption keys. Once connected, only 802.1x. DHCP (Dynamic Host Configuration Protocol) configuration protocol), IP, and h. such protocols are not allowed. Extensible Authentication Protocol (EAP) (RFC 2284) is used for user authentication.

RESULTS

There are many benefits to using wireless technology. While this technology gives users the feeling of being able to move around without losing touch, it provides a great opportunity for network developers to build connections. It also allows you to create many new devices to use the network. But wireless technology poses more threats than conventional wired networks. To create a secure wireless application, you need to identify all the routes through which wireless "attacks" can be transmitted. Unfortunately, apps are never completely secure, but a careful study of the risks of wireless technology can help increase the level of protection in any case. This means analyzing potential threats and building the network in such a way that it is able to prevent attacks and be prepared to defend against non-standard "attacks".

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DISCUSSION

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CONCLUSION

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УДК.515.2

ЁЙИЛМАЙДИГАН ЧИЗИҚЛИ СИРТЛАР ҚОЛИПЛАРИНИНГ АРХИТЕКТУРАВИЙ КОМПОЗИЦИЯСИ

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Аннотация. Мазкур илмий мақолада ёйилмайдиган чизиқли сиртлар қолипларининг архитектуравий композициясини ҳосил қилиш қонунияти асосини чизма геометрия фанида ўрганилиши натижасида каноид, цилиндоид, параболоидлар кўриб чиқиш масалалари ҳақида фикр юритилган.

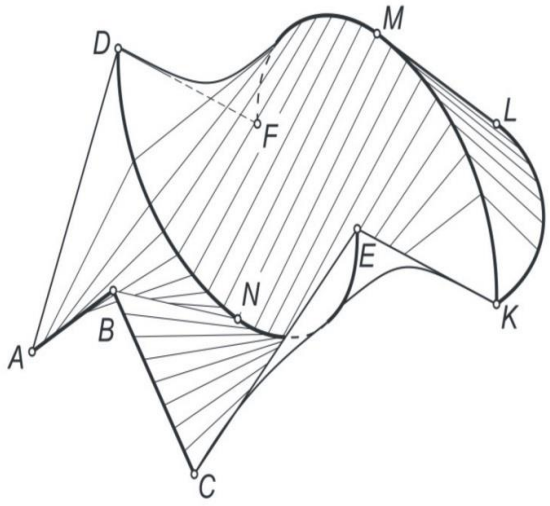
Калит сўзлар. Каноид, цилиндоид, параболоид, дискрет нуқталар, аксиоматик, композиция, компьютер геометрия, синтетик, формал модел, анаметик, параметр, комплекс, перспектива.

Кириш. Ёйилмайдиган чизиқли сиртларни ҳосил қилиш қонунияти чизма геометрия фанида ўрганилади. Сиртлар йўналтирувчиларининг формасига асосан, ёйилмайдиган чизиқли сиртлар коноид, цилиндроид, параболоид турларига бўлинади (1, 2-расмлар).

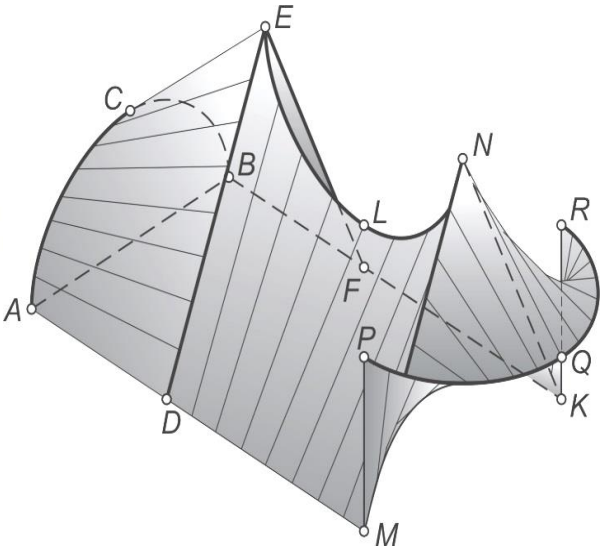
Ушбу сиртларни компьютер графикаси усулида тасвирлаш учун, қуйидаги алгоритмлардан фойдаланилади.

- Сиртни ҳосил қилувчи йўналтирувчилар қолип режасига жойлаштирилади[1] [1]

- Ясовчи, (арматура ёки синтетик толалардан) иборат йўналишни, йўналтирувчи чизиқлар устида ўлчанган координаталар бўйича қўйиб чиқилади.



1-расм.



2-расм.

[1] Михайленко В.Е. и другие. “Формообразование оболочек в архитектуруре”. – К. «Будивельник». 1972 г. 104 – 107 стр.

Бунга биз формаллашган геометрик модели деб таъриф берамиз. Формал моделдан компьютер геометрия моделига ўтиш учун, қуйидаги аналитик тенгламани режага нисбатан ёзамиз:

- Сирт тенгламасидан бошқарув параметрларини аниқлаймиз;
- Тенгламанинг координаталарини исботлашни қулай вазиятга келтирамиз;
- Сиртнинг координаталарини ҳисоблаш ва арматуралар йўналишини компьютер графикасида топиш учун, сирт тенгламасини дискрет нуқталарда ёзиш талаб қилинади.

Ёйилмайдиган чизиқли сиртларни компьютер графикаси усулида тасоввур қилиш ва тасвирлаш учун, махсус график дастурлар таъминотидан ва аксиоматик алгоритмдан фойдаланилади.

Уларга қуйидагилар киради:

- Берилган ўлчамли режани чизиб олиш;
- Берилган режада арматуралар жойлашуви натижаларини ўрганиш;
- Йўналтирувчи чизиқнинг формасини чегаравий чизиққа ўрнатиш;
- Ясовчиларини бир номли координаталарда туташтириш.

Ёйилмайдиган чизиқли сиртларнинг архитектуравий композициясини топиш учун, сирт қолипларини комплекс режада жойлаштириш талаб қилинади. Ушбу аксиоматик муносабатлар қуйидагича ёзилади:

- Компьютер ҳотирасидан йўналтирувчи чизиқлар параметрлари ёрдамида аниқланади;
- Йўналтирувчи чизиқлар режада жойлаштирилади;
- Компьютер графикасининг буриш, суриш, қўйиш, айлантириш, катталаштириш ва кичрайтириш масштабларидан фойдаланиб, композиция тузилади;
- Қолипларни жойлаштиришдан ҳосил бўлган архитектуравий композиция масштаблари аниқланади;
- Тасоввур ва тасвирлар аксонометрик ёки перспектив кўринишда лойиҳаланади[2] [2].

Қолипларнинг архитектуравий композицияси тентлар ёки синтетик ёпилмалар кўринишига келтириш учун, компьютер графикасининг махсус дастурий таъминот қўлланилади. Юқорида келтирилган мантиқий фикрлар амалда чизма геометрия, компьютер геометрияси, компьютер графикаси услубини ёйилмайдиган чизиқли ёпилмаларнинг қолипларини назарий асослашни ва амалий архитектуравий композиция лойиҳаларини тузишни кўриб ўтамиз:

1. Ёйилмайдиган сиртнинг формал геометрик модели коноид бўлсин.

Геометрик шартлар қуйидагича берилган бўлсин:

- Биринчи йўналтирувчи айлана, эллипс, парабола ва ҳоказо ихтиёрий эгри чизиқ бўлиши мумкин. Иккинчи йўналтирувчи тўғри чизиқдан иборат бўлиб, ихтиёрий вазиятда жойлашади;

Ясовчи тўғри чизиқ (арматура) – режага параллел жойлашган деб, қабул қиламиз.

2. Коноид сирт компьютер геометриясида қуйидагича аниқланади:

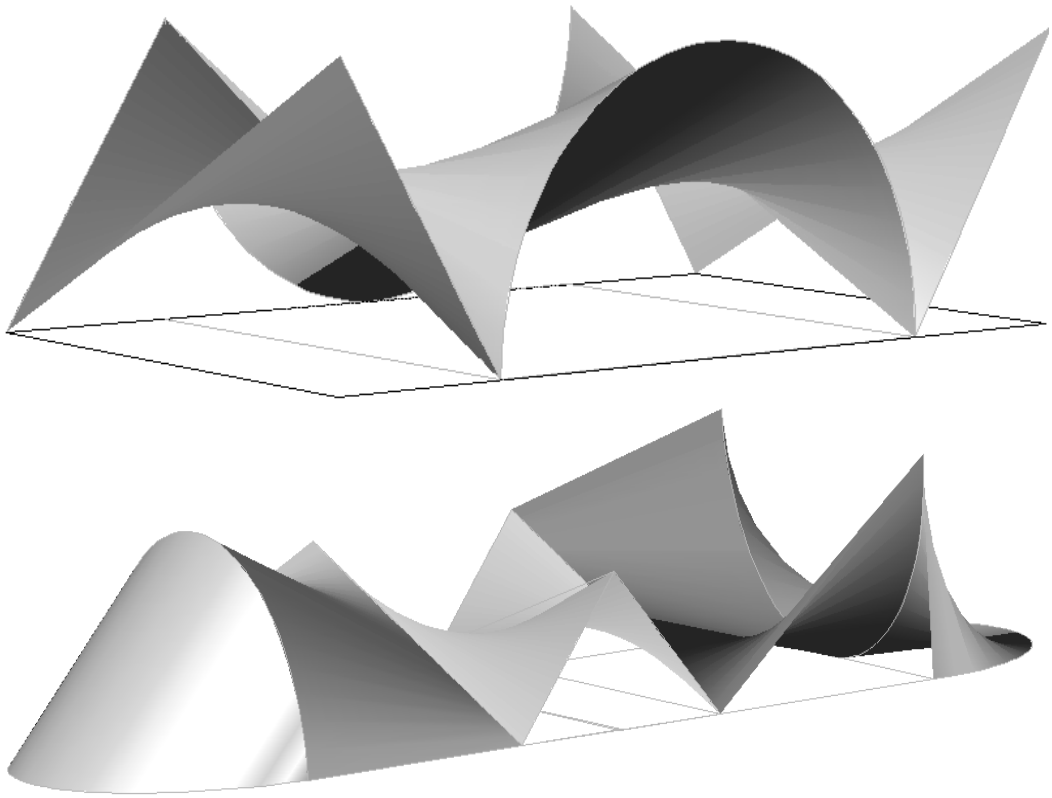
- Биринчи йўналтирувчи чизиқ устида $M(x_o, y_o, z_o)$ нуқта олинади;

[2] Глоголов Н.А. “Проективная геометрия”. – М., Высшая школа, 1973 г.

- Иккинчи йўналтирувчи чизиқда $M(x_o, y_o, z_o)$ нуқтадан уринма текислик ўтказилади;

-Тўғри чизиқнинг уринма текисликда ётиши ва нуқтадан ўтишлик шартлари аниқланади.

3-расмда сирт қолиплари композициясининг компьютер графикаси моделлари келтирилган.



3-расм.

Ҳаракат параметрлари ёрдамида ясовчиларнинг ўрнини аниқловчи коноид сиртининг тенгламаси ҳосил қилинади ва координата услубида қуйидагича ёзилади:

$$y = xtg\frac{z}{h} \quad \text{ёки} \quad \frac{y}{x} = tg\frac{z}{h}, \ \frac{z}{h} = arctg\frac{y}{x},$$

$$z = harctg\frac{y}{x}$$

коноид сиртининг тенгламаси келиб чиқади.

Компьютер графикасига ўтиш учун, сирт тенгламасини дискрет кўринишга келтирамиз.

$$z_i = harctg\frac{y - y_i}{x - x_i} \qquad i=1, 2, 3, \ldots n$$

1-таъриф. Ёйилмайдиган чизиқли сиртлар йўналтирувчиларининг формаларини ва режага нисбатан вазиятини ўзгартириш натижасида сиртларнинг компьютер геометрияси ахбороти яратилади.

2-таъриф. Ёйилмайдиган чизиқли сиртларнинг компьютер графикасида тасвирлаш учун, амалий дастурларнинг компьютер геометрияси кутубхонасидан фойдаланилади [2].

3-таъриф. Ёйилмайдиган чизиқли сиртларнинг архитектуравий композициясини тузиш учун, сирт тенгламасидаги ҳаракат параметрлари лойиҳалаш амалиёти стандартларига мос келувчи қийматлар қўйилади.

Юқорида келтирилган мантиқий геометрик натижалар асосида ёйилмайдиган чизиқли сиртларнинг геометрик модели тенгламасини қуйидаги кўринишга келтирамиз:

$$\frac{x - r\cos\dfrac{z}{a_1}}{\dfrac{a_2^2 + z^2 - a - z^2 r\cos\dfrac{z}{b_1}}{2(a-a_2)}} = \frac{y - r\sin\dfrac{z}{a_1}}{\sqrt{r_2 - (\dfrac{a_2^2 + z^2 - a^2 - r^2}{2(a-a_2)} + a_2)^2 - \sin\dfrac{z}{b_1}}}.$$

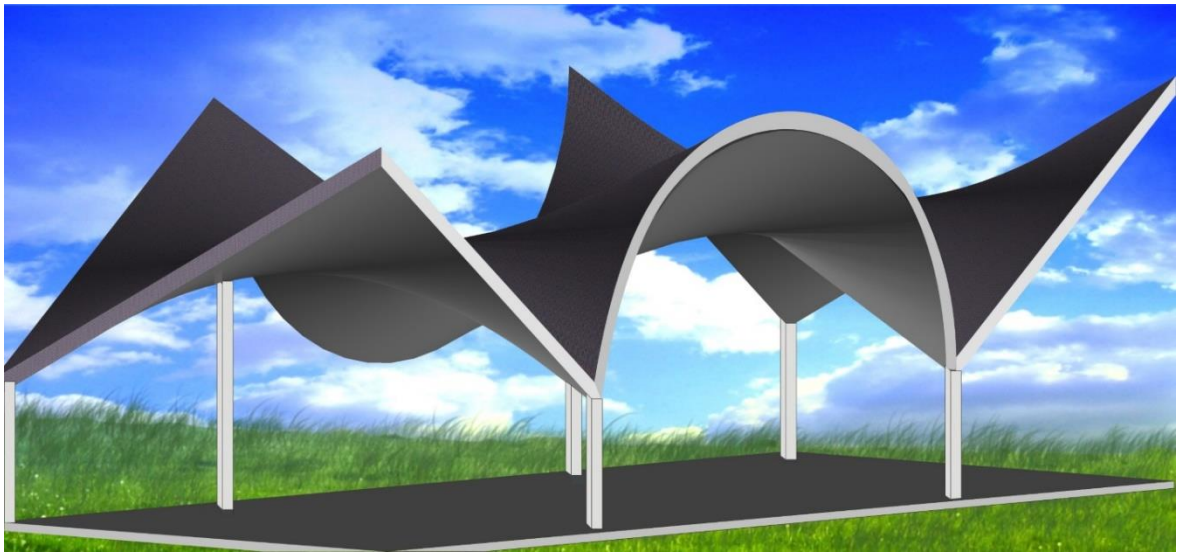
Агар, Ушбу тенгламани дискрет кўринишда ёзсак, фуйидаги компьютер геометриясининг ҳисоблаш формуласи келиб чиқади:

$$\frac{(x - x_i) - r\cos\dfrac{z_1}{a_1}}{\dfrac{a_2^2 + z^2 - a - z^2}{2(a-a_2)} r\cos\dfrac{z_i}{a_1}} = \frac{(y - y_i) - r\sin\dfrac{z_i}{a_1}}{\sqrt{r^2 - (\dfrac{a_2^2 + z_o^2 - a^2 - r^2}{2(a-a_2)} + a_2)^2 - r\sin\dfrac{z_i}{b_1}}}.$$

бу ерда $0 \le x - x_i \le 1$, $0 \le y - y_i \le 1$, $0 \le r \le 1$, $0 \le a_1 \le 1$, $0 \le a_2 \le 1$, $0 \le r_i \le 1$

z_i – ясовчи чизиқнинг координаталарини ушбу тенгламага қийматлари орқали қўйиш натижасида, йўналтирувчилари ҳар хил бўлган вазиятда жойлашган архитектуравий композицияни ҳосил қилиш мумкин.

4-расмда қолипларнинг архитектуравий композицияси келтирилган. Архитектуравий композиция тузиш учун, сиртларнинг кутубхонасидан оралиқ вариантлар олинади.



4-расм.

Юқорида келтирилган мисоллардан қуйидагича хулоса чиқариш мумкин, чизиқли сиртнинг – сирт ясовчисининг ҳамма вақт бир неча параметрли фазовий сиртларни ҳосил қилиш ҳамда амалиётда қўллаш мақсадга мувофиқ бўлади.

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TA‘LIMDA AXBOROT TEXNOLOGIYALARIDA CLIL METODOLOGIYASI YORDAMIDA O'QITISH

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Annotatsiya: Maqolada OTM talabalari uchun TAT (ta‘limda axborot texnologiyalari) o'qitishda CLIL (Content and Language Integrated Learning) metodologiyasini qo'llashning uslubiy va tashkiliy jihatlari tahlil qilingan. Evropa Ittifoqi mamlakatlari, Buyuk Britaniya, Finlandiya ta'lim yo'nalishlarida fanlararo integratsiyani eng faol joriy etuvchi va fanlararo yondashuvni targ'ib qiluvchi davlatlar hisoblanadi. Tadqiqotning istiqbolli yo'nalishi-bu fanlarni chet tilida o'qitishning CLIL metodologiyasidan foydalangan holda yangi integratsiyalashgan fan-til dars ishlanmalarini ishlab chiqish.

Abstract: The article analyzes the methodological and organizational aspects of the use of CLIL (Content and Language Integrated Learning) methodology in teaching ITE (information technology in education) for university students. The countries of the European Union, the United Kingdom, and Finland are the countries that actively introduce interdisciplinary integration in education and promote the interdisciplinary approach. A promising area of research is the development of new integrated science-language lesson plans using the CLIL methodology of teaching subjects in a foreign language.

Kirish. Bizning davrimizda turli fanlarning g'oyalari va usullarining o'zaro kirib kelishi tipologik xususiyat hisoblanadi. Integratsiya - bu jamiyatning ekologik, iqtisodiy va ijtimoiy muammolarini hal qilish uchun zarur bo'lgan kompleks yondashuvdir. Jamiyat hayotida yuz berayotgan o'zgarishlar, ta'limning yangi usullari, shaxsning individual rivojlanishi va ijodiy tashabbusi bilan shug'ullanadigan pedagogik texnologiyalarni ishlab chiqishni talab qiladi. Jamiyatga o'ylaydigan va izlay oladigan ijodkor kerak. Zamonaviy sharoitda odam murakkab muammolarni hal qilishi, harakatning turli variantlarini o'rganishi va aniqlashi, muammolar bilan hayotdagi yangi qiyinchiliklarga qarshi turishi kerak bo’ladi.

Zamonaviy pedagogika fani zamonaviy oliy ta'limning eng dolzarb yo'nalishlaridan biri bo'lgan va kasbiy bilimlar, fan-til va umumiy til kompetentsiyalarini birlashtirgan CLIL-ning tubdan yangi modelini ishlab chiqishning nazariy kontseptsiyasini ishlab chiqishga qaratilgan. Bu kombinatsiya pedagogik, psyxologik va uslubiy muammolar majmuasini o'z ichiga oladi.

CLIL - bu fan (tarkib) va tilni integratsiyalashgan o'qitishning qisqartmasi [1]. Shu bilan birga, CLIL atamasi 1994 yilda Finlyandiyada Devid Marsh tomonidan ishlab chiqilgan bo'lib, u qisman Kanada va Buyuk Britaniyada ikki tilli ta'lim dasturlari misollariga asoslangan Evropada rivojlanib borayotgan yondashuvni tasvirlash uchun ishlatilgan [2].

CLIL texnologiyasini joriy etishda ba'zi qiyinchiliklarga qaramay, u bizga ta'lim vazifalarining keng doirasini hal qilishga imkon beradi. TAT fanini chet tilida o'rganish ta'lim maqsadlariga erishishning qo'shimcha vositasi bo'lib, o'quvchilarning axborot va til malakalarini shakllantirishning bir vaqtning o'zida ijobiy tomonlariga egadir.

CLIL qobiliyatlarni rivojlantirishni, o'quv jarayonini qayta ko'rib chiqishni, o'rganish motivatsiyasini va muloqot qobiliyatlarini shakllantirishni ta'minlaydi. Ishning dolzarbligi shundan iboratki, chet tilini o'rganishda integratsiyalashgan jarayonning fanlararo yondashuvi, ta'lim muhitini rivojlantirishning muhim tendentsiyasi hisoblanadi.

Maqsad: CLIL metodologiyasining TAT darslarida chet tilida qo'llanilishini tahlil qilish.

Tadqiqot maqsadini amalga oshirishda bir qator vazifalarni hal qilishni o'z ichiga oladi:

- CLIL metodologiyasini joriy etishning jahon tajribasini tahlil qilish va uning afzalliklarini aniqlash;

- mavzu-til integratsiyasini amalga oshirish yo'llarini izlash;

- TAT va chet tili integratsiyasining shartlari va tamoyillarini o'rganish va aniqlash;

- shartlarni tahlil qilish asosida, TAT fanini o'qitishda CLIL metodologiyasini keyinchalik qo'llash bo'yicha xulosalar va tavsiyalar tuzish.

Ma‘lumotlar va metodlar. Belgilangan vazifalarni hal qilish va maqsadga erishish uchun tadqiqot usullari to'plamidan quyidagicha foydalanildi:

Nazariy usullar: lingvodidaktik, ilmiy va uslubiy, psixologik va pedagogik adabiyotlarni va eksperimental tadqiqot natijalarini o'rganish va tahlil qilish; nazariy va empirik material sintezi; universitetlarning haqiqiy o'quv dasturlarini tahlil qilish;

Empirik usullar: pedagogik tajribani o'rganish va umumlashtirish; ta‘lim faoliyatini kuzatish; eksperimental o'rganish;

Tashxis usullari: kuzatish, tekshirish, mashqlar, topshiriqlar bajarish, TAT va chet tili o'qituvchilari faoliyati natijalarini tahlil qilish.

Bu integratsiyalashgan yondashuv tanlangan tadqiqot sohasini har tomonlama tahlil qilishni ta'minlaydi. Ishning amaliy ahamiyati shundaki, uning natijalari O’zbekiston oliy o'quv yurtlarida fan-til integratsiyasini yanada amalga oshirish uchun ishlatilishi mumkin.

Evropada ba'zi o'quv fanlari bir necha o'n yillar davomida chet tilida o'qitilgan. CLIL sohasidagi ilmiy-tadqiqot Yevropa tashkilotlari va bir qator ta'lim muassasalarida olib boriladi.

Turli mamlakatlarda CLIL metodologiyasini joriy etish xususiyatlari tanlangan modelga bog'liq. Shunday qilib, CLILning uchta modeli ma'lum: yumshoq (tilga asoslangan), qattiq (mavzuga asoslangan), qisman yuklanish (partial immersion). Birinchi model maxsus kontekstning lingvistik xususiyatlariga qaratilgan bo'lsa, ikkinchi mutaxassislik fanlari o'quv rejasining 50% chet tilida o'rganiladi va uchinchisi oraliq o'rinni egallaydi ya’ni mutaxassisliklar dasturidan ayrim modullar chet tilida o'rganilganda qo'llaniladi.

Shunday qilib, CLIL har xil ta'lim kontekstlari va tizimlariga osongina moslasha oladi. TAT fanini chet tilida o'qitishning integratsiyalashgan yondashuvidan foydalanish mantiqiy tuzilgan va kontseptual asosga ega bo'lgan tizimni tashkil etadi, bunda tilning foydalilik qiymati fan mazmunini o'zlashtirish uchun kuchli motivatsiyaga aylanadi.

Natijalar. TAT fanini "asl tilda" o'rganish (axir hammaga ma'lumki, AKT terminologiyasining deyarli barchasi ingliz tilida) o'quv imkoniyatlarini kengaytirishga hissa qo'shadi va mazmunli vazifalar bilan to'ldirilgan interaktiv platforma bo'lgan o'quv muhitini yaratishga yordam beradi TAT fanini integratsiyalashgan o'qitish jarayonida chet tili faqat o'quv fani bo'lishni to'xtatadi, balki aloqa va kerakli ma'lumotlarni olish vositasiga aylanadi.

TAT o'qituvchilarining faoliyatini va o'quvchilarning o'quv mashg'ulotlarini integratsiyalashgan sinflar sharoitida kuzatish natijasida, TAT fanini chet tilida o'qitish quyidagilarga imkon beradi, degan xulosaga kelish mumkin.

- axborot qobiliyatini rivojlantirish ;

- shaxsning har tomonlama rivojlanishini ta'minlaydigan texnologiyalardan foydalanishni o'rgatish ;

- axborot jamiyatida hayotga moslashish.

Birlashtirilgan TAT va chet tili darslarida CLIL metodologiyasini samarali qo'llash uchun quyidagilar zarur:

- hozirgi va qiziqarli axborot sahih o'quv materiallar;
- TAT va chet tili o'qituvchilari tomonidan birgalikda o'quv jarayonini qo'llab -quvvatlash;
- o'quv jarayonining barcha ishtirokchilarining faol o'zaro ta'siri va chet tillarini samarali bilishi;

Muhokama. J. Xanter va U. Smitning so'zlariga ko'ra, CLIL texnologiyasi bir qancha afzalliklarga ega bo'lib, bu usul chet tillarni o'qitish jarayonida foydalanish samaradorligini ishonchli tarzda ko'rsatadi. Birinchidan, ong, madaniyat va muloqot kabi jihatlarni ikki bosqichli - mavzuning mazmuniga va chet tiliga yo'naltirish orqali integratsiya qilish qobiliyatini oshiradi, ikkinchidan, chet tilini samarali o'zlashtirish qobiliyati va shu bilan birga, o'z tafakkurining tanqidiyligi va harakatchanligini rivojlantirishga yordam beradi. Nihoyat, etarli darajada moslashuvchanlik o'qituvchilarga yuqoridagi metodologiyani turli kontekstlarda qo'llashda yordam beradi [3].

Tadqiqotchilarning fikriga qo'shilib, CLIL texnologiyasi orqali til ko'nikmalari va bilimlarini oshirishda hech qanday cheklovlar yo'q deb hisoblaymiz. CLIL shuningdek, talabalarga madaniyatlararo bilimlarini rivojlantirish uchun keng imkoniyatlar yaratadi.

Bundan tashqari, talabalar o'rganilayotgan tilning madaniyatini yaxshiroq o'rganish va tushunish imkoniyatiga ega bo’ladi, bu esa ijtimoiy-madaniy kompetentsiyaning shakllanishiga yordam beradi.

Shunday qilib, CLIL metodologiyasi o'quv dasturida qo'shimcha soat talab qilmasdan, TAT fanini chet tili hisobidan mustahkamlashga imkon beradi, deb ta'kidlaymiz.

Xulosa. CLIL yoki kontent va tilni integratsiyalashgan o'rganish - bu chet tilidagi vositalardan foydalangan holda fanni o'qitish metodikasi, uning asosiy maqsadi - bu mavzuni o'rganish va til ko'nikmalarini yaxshilashdir. Bu metodologiya yangi emas. U uzoq vaqtdan beri Evropa mamlakatlarining turli universitetlari, masalan, Finlyandiya, Vengriya, Boltiqbo'yi davlatlari (Litva, Estoniya), shuningdek Buyuk Britaniya, Kanada, AQSh va boshqa mamlakatlar tomonidan qo'llanilgan.

CLILning muvaffaqiyatli qo'llanilishi ushbu metodologiyaning yuqori salohiyatidan dalolat beradi. Ko'pgina olimlarning fikricha, CLILdan foydalanish katta istiqbolga ega, ammo uni amalga oshirish o'quv jarayonini tashkil etish bo'yicha an'anaviy kontseptsiya va qarashlarni qayta ko'rib chiqishni talab qiladi. Globallashuv jarayoni bilan bog'liq holda chet tilini o'qitishning birinchi bosqichida islohotlarga bo'lgan ehtiyoj dunyoning aksariyat mamlakatlari ta'lim tizimida CLIL metodologiyasini faol ravishda o'zlashtirishga yordam beradi.

Metodologiyaning afzalliklaridan biri shundaki, u fan bo'yicha til ko'nikmalari va bilimlarini oshirishda hech qanday cheklovlarga ega emas. CLIL shuningdek, talabalarga madaniyatlararo bilimlarini rivojlantirish imkoniyatini beradi. Metodologiya boshqa ta'lim strategiyalaridan foydalanishga, o'qitishning innovatsion usullari va texnologiyalarini qo'llashga yordam beradi va o'quvchilarning bir vaqtning o'zida TATlari va chet tilini o'rganishga bo'lgan qiziqishini oshiradi. Yuqorida sanab o'tilgan afzalliklardan tashqari, CLIL o'quv dasturida qo'shimcha soat talab qilmasdan, chet tili hisobidan TAT fanini o'rganishni yaxshilash imkoniyatini beradi.

Tarkibiy va tilli integratsiyalashgan o'qitish modeli bitta sohadagi ko'nikmalarni bir butun tizimga birlashtirishga imkon beradi, bu esa axborot texnologiyalari va chet tillarini bilish darajasini yaxshilaydi.

Oliy ta‘lim muassasalarida CLIL metodologiyasini yanada joriy etish va yangi kontent va til integratsiyalangan dars ishlanmalarini ishlab chiqish istiqbolli hisoblanadi.

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РЕШЕНИЕ ЗАДАЧИ КОШИ РАЗЛОЖЕНИЕМ В СТЕПЕННОЙ РЯД

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Аннотация: В данной статье выражается решение задач Коши разложением в степенной ряд на основе современных технологий. Задачи Коши решались с помощью программы Maple.

Ключевые слова: DiffSer(), intDiff(), piecewise(), DiffInner(), Функция Тейлора, математический маятник.

Применение рядов для решения ДУ рассмотрим на примере нелинейного уравнения второго порядка вида $y'' = f(x, y, y')$ удов

летворяющего начальным условиям $y(x_0) = y_0$, $y'(x_0) = y_0'$.

Предположим, что решение поставленной задачи существует и будем его искать в форме ряда Тейлора функции y(x).

$$y(x) = y(x_0) + y'(x_0)(x - x_0) + \frac{1}{2}y''(x_0)(x - x_0)^2 + \ldots$$

Для построения решения нужно знать производные в точке x0 порядка 1, 2, 3, …, но это можно сделать с помощью самого уравнения и его начальных условий. Действительно, из начальных условий мы сразу имеем значение функции и ее первой производной в точке x_0. Подставляя их в уравнение, сразу находим значение 2-й производной $y''(x_0) = f(x_0, y_0, y_0')$ Дифференцируя обе части исходного уравнения по аргументу x, получим выражение для 3-й производной

$$y''' = \frac{\partial f(x, y, y')}{\partial x} + \frac{\partial f(x, y, y')}{\partial y}y' + \frac{\partial f(x, y, y')}{\partial y'}y''$$

Подставляя в правую часть $x = x_0$ и значения предыдущих производных в этой точке, находим значение 3-й производной $y'''(x_0)$ в точке $x = x_0$. Дифференцируя последнее выражение еще раз, и выполняя подстановку известных производных, находим значение 4-й производной в точке $x = x_0$. Для определения производных функции y(x) в точке x_0 до требуемого порядка n дифференцирование и подстановку выполняем необходимое число раз. Затем найденные значения производных подставляем в представление решения в форме ряда Тейлора. Для тех значений x для которых этот ряд сходится, он будет представлять искомое решение задачи Коши.

Для решения задачи Коши $y'' = f(x, y, y')$, $y(x_0) = y_0$, $y'(x_0) = y_0'$ используем следующую процедуру(см.[1],стр.450).

```
DiffSer:=proc(f::anything,x::name,y::name,y1::name,\
x0::numeric,y0::numeric,y01::numeric,n::integer)
```

```
local p,der,i,j,s:
m0||1:=y01:
m0||2:=subs(x=x0,y=y0,y1=y01,f);
der:=subs(y1=m1,f);
p:=y0+m0||1*(x-x0)+m0||2*(x-x0)^2/2:
 for i from 3 to n do
s:=0:
for j from 1 to i-2 do
s:=s+diff(der,m||j)*m||(j+1);
end do:
der:=diff(der,x)+diff(der,y)*m||1+s;
m0||i:=eval(der,{x=x0,y=y0,seq(m||k=m0||k,k=1..i-1)});
p:=p+(m0||i)*(x-x0)^i/i!; end do;
end proc:
```

Аргументами процедуры являются выражение для правой части ДУ (f), имена независимой переменной (x), неизвестной функции (y) и ее производной (y'), а также параметры x_0, y_0, y_0', определяющие условия задачи Коши. Порядок усечения ряда n, задаваемый последним параметром, указывает, что последний член ряда будет иметь вид $a_n(x-x_0)^n$.

Операторы расположенные до первого цикла for формируют первые 3 члена ряда. В цикле for вычисляются оставшиеся производные и их значения в точке $x = x_0$, а также формируется ряд. В процедуре для всех появляющихся при последовательном дифференцировании производных решения используются обозначения mN, где N – порядок производной, а для их значений в точке x_0 используются переменные m_0N.

Пример 1. Решить следующую задачу Коши: $\frac{\partial^2}{\partial x^2} y = -yx^2,\ y(0)=1,\quad \frac{d}{dx} y(0)=0.$

```
s:=DiffSer(-y*x^2,x,y,y1,0,1,0,20);
```

$$s := 1-\frac{1}{12}x^4+\frac{1}{672}x^8-\frac{1}{88704}x^{12}+\frac{1}{21288960}x^{16}-\frac{1}{8089804800}x^{20}$$

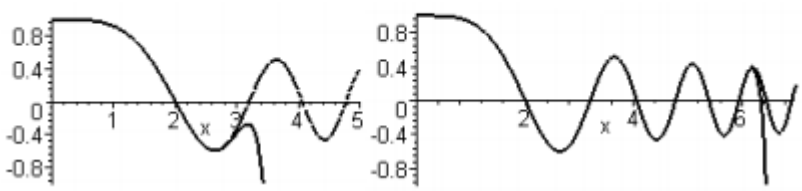
Выбранная задача имеет точное решение.

```
dsolve({diff(y(x),x$2)=-y(x)*x^2,y(0)=1,D(y)(0)=0},y(x));
s1:=rhs(%);
```

$$y(x)=\frac{1}{2}\Gamma\left(\frac{3}{4}\right)\sqrt{x}\,BesselJ\left(\frac{1}{4},\frac{x^2}{2}\right)-\frac{1}{2}\Gamma\left(\frac{3}{4}\right)\sqrt{x}\,BesselY\left(\frac{1}{4},\frac{x^2}{2}\right)$$

Для сравнения построим графики точного и приближенного решений. На следующем графике слева показано точное решение и приближенное до 20 – й степени, а справа до 100-й степени..

```
plot([s,s1],x=0..5,- 1..1,
color=BLACK,thickness=2,linestyle=[1,4]);
```



Как видим, увеличение числа членов ряда расширяет интервал аппроксимации решения.

Пример 2. Исследуем колебания плоского математического маятника – точка массы m подвешена на конце нити длины l и находится в однородном поле тяжести. Колебания маятника описываются уравнением $ml^2\varphi'' + mgl\sin\varphi = 0,$

где φ(t) - угол отклонения маятника от положения равновесия. Перепишем это уравнение в виде $\varphi_n' = -\frac{g}{l}\sin\varphi$. Это вид ДУ, который можно решать с помощью процедуры DiffSer.

Для примера выберем m=1, g=1, а начальные условия возьмем следующего вида $\varphi(0) = 0, \quad \varphi'(0) = \frac{1}{8}$ т.е. задана начальная скорость и в нулевой момент времени маятник находится в положении равновесия.

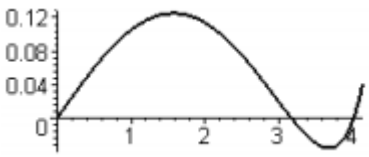
Решим эту задачу Коши с помощью процедуры DiffSer.

```
> s:=DiffSer(-sin(y),x,y,y1,0,0,1/8,14);
```

$$s := \frac{1}{8}x - \frac{1}{48}x^3 + \frac{13}{12288}x^5 - \frac{4801}{165150720}x^7 + \frac{19531}{2174327193\,6}x^9 - \frac{38052343}{765363172\,147200}x^{11} +$$

$$+ \frac{4421087563}{152827718\,2143528960}x^{13}$$

```
> plot(s,x=0..Pi+1,color=BLACK,thickness=2,
linestyle=[1,4],numpoints=1000);
```



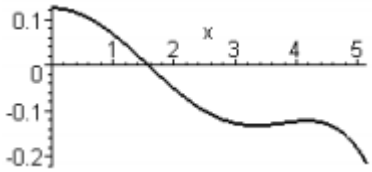
Если начальная скорость не слишком велика, то колебания должны быть периодическими. Мы видим, что наше решение через некоторый промежуток времени принимает нулевое значение, а значит, маятник возвращается в положение равновесия. Вероятно о дальнейшем поведении решения наш ряд ничего не говорит, поскольку начинает сказываться погрешность приближения.

Пример 3. Решим то же ДУ с другими начальными условиями, $\varphi(0) = \frac{1}{8}, \quad \varphi'(0) = 0,$ т.е. задана начальное отклонение относительно положения равновесия, а начальная скорость равна 0.

```
> s:=DiffSer(-sin(y),x,y,y1,0,1/8,0,9):
evalf[5](s);
```

$$0.12500 - 0.062335x^2 + 0.0051542x^4 - 0.00016239x^6 + 0.14468\cdot 10^{-5}x^8$$

```
> plot(s,x=0..Pi+2,color=BLACK,thickness=2,
linestyle=[1,4],numpoints=1000);
```



Из графика видно, что материальная точка возвращается в положение равновесия, затем удаляется от него в противоположном направлении. Для больших моментов времени полученное решение применять нельзя. Построить решение в форме ряда можно и другим способом. В этом способе решение y(x) представляется в виде степенного ряда с неопределенными коэффициентами

$$y(x) = a_0 + a_1(x - x_0) + a_2(x - x_0)^2 + a_3(x - x_0)^3 + \ldots\ldots$$

Этот ряд подставляется в левую и правую части уравнения $y'' = f(x, y, y')$ причем все функции правой части также раскладываются в степенные ряды. Далее выполняются необходимые вычисления с рядами правой части для представления ее в виде одного степенного ряда. Приравнивая в левой и правой части коэффициенты при одинаковых степенях $(x - x_0)^n$, получим систему линейных уравнений относительно неизвестных коэффициентов ряда a_n

В работе [1] стр.453 приведена процедура решения задачи Коши для ДУ 2-го порядка, имеющей вид $y'' = f(x, y, y')$, $y(x_0) = y_0$, $y'(x_0) = y_0'$, реализующая

описанный алгоритм. Вот ее код.

```
intDiff:=proc(f::anything,x::name,y::name,y1::name,\
x0::numeric,y0::numeric,y01::numeric,n::integer)
local p,pL,i,s,a,result:
p:=y0+y01*(x-x0):
 result:=p+sum(a[i]*(x-x0)^i,i=2..n);
 p:=p+sum(a[i]*(x-x0)^i,i=2..n+2);
pL:=series(subs(y=p,y1=diff(p,x),f),x=x0,n+1);
for i from 0 to n do
 eq||i:=coeff(diff(p,x$2)-convert(pL,polynom),x,i)=0;
 end do:
s:=solve({seq(eq||i,i=0..n)},{seq(a[i],i=2..n+2)});
assign(s); eval(result);
end proc:
```

Аргументы этой процедуры имеют тот же смысл, что и аргументы предыдущей процедуры. В теле процедуры введен промежуточный ряд, имеющий слагаемых на 2 больше, чем требуемое число членов, т.к. его приходится дважды дифференцировать. Отметим, что эта процедура работает быстрее предыдущей.

Пример 4. Решим задачу Коши $xy'' + y' + xy = 0, \quad y(0) = 1, \quad y'(0) = 0$. Для решения это уравнение с помощью разработанной процедуры, преобразуем его к виду $y'' = -\frac{y'}{x} - y$. Отметим, что функция правой части при x=0 не определена. Поэтому применение

процедуры реализующей первый способ построения решения в виде ряда не представляется возможным, т.к. ее алгоритм предполагает вычисление правой части в точке x=0. Но в методе поиска неопределенных коэффициентов, реализованном в последней процедуре, значение правой части в этой точке не вычисляется.

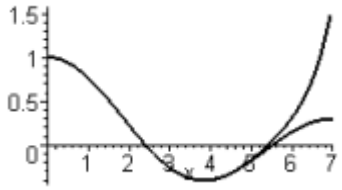
```
> s:=intDiff(-y1/x-y,x,y,y1,0,1,0,12);
```

$$1-\frac{1}{4}x^2+\frac{1}{64}x^4-\frac{1}{2304}x^6+\frac{1}{147456}x^8-\frac{1}{15745600}x^{10}+\frac{1}{2123366400}x^{12}$$

```
> s1:=dsolve({x*diff(y(x),x$2)+diff(y(x),x)+x*y(x)=0,
 y(0)=1,D(y)(0)=0},y(x));
```

$$s1 := y(x) = BesselJ(0, x)$$

```
> plot([s,rhs(s1)],x=0..7,color=BLACK,thickness=2,
linestyle=[1,4],numpoints=1000);
```

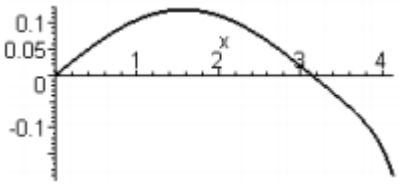


На графике приведено точное решение задачи и приближенное в виде ряда. Расхождение решения в форме ряда с точным решением может происходить по двум причинам. Первая состоит в том, что мы не можем выбрать достаточное количество членов ряда для получения удовлетворительной точности на широком интервале изменения аргумента. Это ограничение связано с ограничением по времени выполнения программы и по объему используемой ею памяти. Вторая причина состоит в том, что большинство рядов имеют конечный радиус сходимости и использование ряда для приближения решения на более широком интервале принципиально невозможно. Выход из создавшегося положения состоит в разбиении интервала поиска решения на отрезки такой длины, в пределах которых степенные ряды будут сходиться и давать приемлемое приближение решения. Вначале строится решение $s_1(x)$ в форме ряда Тейлора на отрезке $[x_0, x_1]$, где мы знаем, что ряд хорошо аппроксимирует решение и сходится. Затем находим значение этого ряда и его производной в точке x_1 и используем эти значения в качестве начальных значений для построения нового ряда $s_2(x)$ разложения решения в окрестности точки x_1 по степеням $(x-x_1)^n$. Построенный ряд используем для определения начальных условий Коши в точке $x = x_2$ и определяем третий ряд аппроксимирующий решение на следующем отрезка поиска решения и т.д. Для иллюстрации этого подхода рассмотрим ДУ описывающее колебания математического маятника.

Пример 5. Для нашей задачи возьмем начальные условия вида $y(0)=\frac{1}{8}, \quad y'(0)=0,$ и для построения решения в форме ряда используем процедуру intDiff.

```
s1:=intDiff(-sin(y),x,'y','y1',0,0,1/8,20):
evalf[3](s1);
plot(s1,x=0..Pi+1,color=BLACK,thickness=2,
 linestyle=[1,4],numpoints=1000);
```

$$0.125x - 0.0208x^3 + 0.00106x^5 - 0.0000291x^7 + 0.898\cdot10^{-6}x^9 - 0.497\cdot10^{-7}x^{11} + 0.289\cdot10^{-8}x^{13} -$$
$$- 0.146\cdot10^{-9}x^{15} + 0.697\cdot10^{-11}x^{17} - 0.351\cdot10^{-12}x^{19}$$



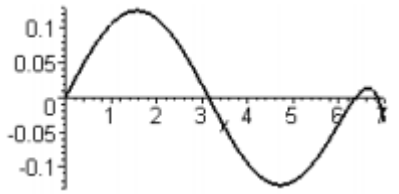
Полученный ряд дает удовлетворительное решение на отрезке [0,3]. Используем x=3 в качестве начальной точки для решения новой задачи Коши. Подставим x=3 в найденный ряд и его производную по x для получения новых значений $y(0) = y_0, \quad y'(0) = y'_0$. Опять решаем задачу Коши используя процедуру intDiff.

```
x0:=3:
y0:=subs(x=x0,s1):
y1:=subs(x=x0,diff(s1,x$1)):
s2:=intDiff(-sin(y),x,'y','y1',x0,y0,y1,14):
 evalf[3](s2);
```

$$0.392 - 0.125x - 0.00895(x-3)^2 + 0.0208(x-3)^3 + 0.000758(x-3)^4 - 0.00106(x-3)^5 -$$
$$- 0.0000291(x-3)^6 + 0.0000287(x-3)^7 + 0.115\cdot10^{-5}(x-3)^8 - 0.857\cdot10^{-6}(x-3)^9 - 0.771\cdot10^{-7}(x-3)^{10}$$
$$+ 0.461\cdot10^{-7}(x-3)^{11} + 0.530\cdot10^{-8}(x-3)^{12} - 0.265\cdot10^{-8}(x-3)^{13} - 0.306\cdot10^{-9}(x-3)^{14}$$

Из двух рядов создаем кусочно-непрерывную функцию и строим ее график.

```
Sser:=x->piecewise(x<=x0,s1,x>x0,s2):
plot(Sser(x),x=0..4,color=BLACK,thickness=2,
linestyle=[1,4],numpoints=1000);
```



Полученная функция уже хорошо приближает решение на отрезке [0,6], где она похожа на синусоиду. Мы это знаем т.к. решение должно быть нечетным и периодическим (задача о колебании маятника). Интересно отметить, что построенная функция непрерывна вместе со своей 1-й производной. Действительно, 1-я производная первого ряда в точке x=3 использована в качестве первой производной второго ряда как начальное значение. Вторая производная в точке стыковки для обеих функций, как правило, будет различной. Для первого ряда она вычисляется подстановкой $x = x_1$ во 2-ю производную первого ряда, а для второй вычисляется по формуле $y''(x) = f(x_1, y_1, y'_1)$. Для реализации метода решения задачи Коши ДУ 2-го порядка разложением в степенной ряд с разбиением на отрезки мы создали специальную процедуру.

```
StepSeries:=proc(f::anything,x::name,y::name,y1::name,\
x0::numeric, y0::numeric, y01::numeric,\
 n::integer,xend::numeric, dlt::numeric)
 local i,nn,DiffInner;
```

```
# Внутренняя процедура разложения решения в ряд
# в окрестности 0
DiffInner:=proc(f::anything,x::name,y::name,y1::name,\
y0::Or(numeric,realcons),\
y01::Or(numeric,realcons),n::integer)
localp,pL, i,s,a,result:
p:=y0+y01*x:
result:=p+sum(a[i]*x^i,i=2..n);
p:=p+sum(a[i]*x^i,i=2..n+2);
 pL:=series(subs(y=p,y1=diff(p,x),f),x=0,n+1);
for i from 0 to n do
eq||i:=coeff(diff(p,x$2)-convert(pL,polynom),x,i)=0;
 end do:
s:=solve({seq(eq||i,i=0..n)},{seq(a[i],i=2..n+2)});
assign(s);
 eval(result);
end proc:
nn:=floor((xend-x0)/dlt): # число точек стыковки
# Второе число X0i,Y0i,Y1i указывает номер шага i
X0||0:=x0: Y0||0:=y0: Y1||0:=y01:
s||1:=DiffInner(f,x,y,y1,Y00,Y10,n):
for i from 1 to nn-1 do
X0||i:=x0+dlt*i:
Y0||i:=evalf(subs(x=dlt,s||i));
Y1||i:=evalf(subs(x=dlt,diff(s||i,x$1)));
s||(i+1):=DiffInner(f,x,y,y1,Y0||i,Y1||i,n):
end do:
piecewise(seq(op([x<=X0||i,subs(x=x-X0||(i1),s||i)]),i=1..nn-1),\
subs(x=x-X0||(nn-1),s||nn));
end proc:
```

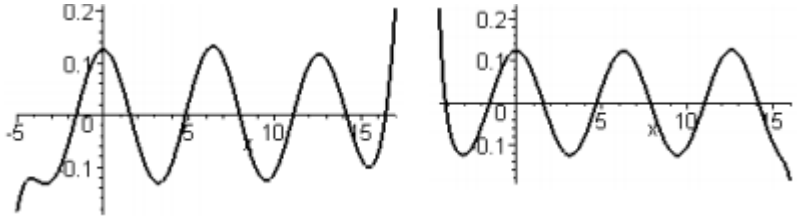
Аргументами процедуры являются выражение для правой части ДУ (f), имена независимой переменной (x), неизвестной функции (y) и ее производной (y'), а также параметры x_0, y_0, y_o', определяющие условия задачи Коши. Порядок усечения рядов задаваемый параметром n, указывает, что их последние члены будут иметь вид $a_n(x-x_0)^n$. Эти аргументы в точности те же, что и у процедуры DiffSer. Последние два параметра определяют конец интервала поиска решения xend (оно ищется на интервале [x_0, xend]) и длину отрезков на которые разбивается этот интервал – dlt. Это означает, что будут построено $N=\left[\frac{xend-x_0}{dlt}\right]$ степенных рядов, которые будут стыковаться в точках $x_k=x_0+k\cdot dlt, k=1,2,..,N$. Внутренняя процедура DiffInner идентична процедуре DiffSer и всегда вызывается со значением x_0=0, поэтому DiffInner не имеет этого аргумента. Результатом работы процедуры является piecewise функция, составленная из построенных рядов для которых выполняется преобразование к общей системе

координат (координатная система первого отрезка). Работу процедуры проиллюстрируем на примере уравнения колебания математического маятника. Мы не будем приводить формулы полученной piecewise функции из-за их длины.

Пример 6. Для маятника задано начальное отклонение, а начальная скорость равна 0.

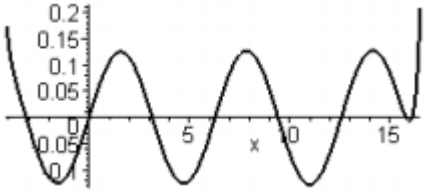
```
st:=time():
x0:=0: y0:=1/8: y1:=0:
r1:=StepSeries(-sin(y),x,'y','y1',x0,y0,y1,8,15,3):
time()-st;
plot(r1,x=-5..11.5,color=BLACK,thickness=2,numpoints=500);
```

На следующем рисунке слева приведен график решения, составленного из многочленов до 8-й степени, а справа –14-й. Оба решения составлены из 5-ти рядов построенных на отрезках [0,3], [3,6], [6,9], [9,12], [12,15]. На левом рисунке заметно некоторое отличие 3-й волны графика от 2-х предыдущих, поэтому для улучшения решения пришлось повысить степень многочленов до 14-ти.



Выбрав другое начальное условие (начальное отклонение 0, начальная скорость не 0) получим следующее решение

```
x0:=0: y0:=0: y1:=1/8:
r1:=StepSeries(-sin(y),x,'y','y1',x0,y0,y1,20,15,3):
plot(r1,x=-4.1..16.5,color=BLACK,thickness=2,numpoints=500);
```

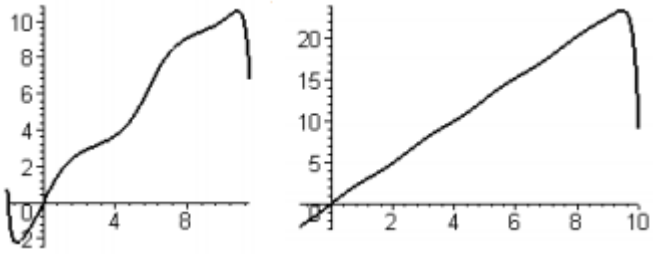


Здесь для построения приемлемого решения пришлось строить многочлены 20-й степени. Полученное решение можно применять на интервале несколько более широком, чем отрезок заданный в аргументе процедуры, поскольку первый ряд применим левее начальной точки x_0, а правый может давать приближение на отрезке несколько более широком, чем dlt. Если мы правильно выбрали параметр dlt, то решение в виде составного ряда будет всегда приемлемым на отрезке [x_0-dlt, xend]. Если начальная скорость достаточно высока (в нашем примере больше 2), то движение маятника перестает быть периодическим (маятник доходит до верхней точки и переваливает через нее). В этом случае угол отклонения маятника возрастает монотонно.

```
st:=time():
x0:=0: y0:=0: y1:=2.05:
r1:=StepSeries(-sin(y),x,'y','y1',x0,y0,y1,12,9,1):
 time()-st;
```

```
plot(r1,x=-1..10,color=BLACK,thickness=2,numpoints=500);
```

На следующем рисунке слева показан график решения при нулевом начальном смещении и начальной скорости y_1=2.05, а на правом – при начальной скорости равной y_1=3. Если начальная скорость достаточно велика, то кривизны графика решения почти незаметно. Легко видеть, что вне отрезка [0,9] построенные решения неприменимы.



Отметим, что для построения последних решений длину отрезков, на которых построены ряды, пришлось брать равной единице, т.е. наши решения составлены из 9 многочленов 12-й степени. Если бы мы не использовали процедуру сшивания рядов, то не смогли бы построить хорошее решение на таком широком интервале изменения аргумента. Отметим также, что периодическое решение, соответствующее колебательному процессу достаточно построить на отрезке равном периоду колебаний, а на более широкий интервал времени решение мы можем продолжить с помощью нашей методики периодического продолжения функций.

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ГАЗ САНОАТИ КОРХОНАЛАРИДАГИ ЧИҚИНДИЛАРДАН СУЛФАТ КИСЛОТА ОЛИШ

Курбанов А.А.[1], Джаксымуратов К[2], Отелбаев Азизбек Алишер ўғли[3]
[1]Д.т.н. преподаватель НГГИ, [2]К-г.м.н. преподователь НФ НГГИ
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АННОТАЦИЯ: Экология,Екологик муаммоларни бартараф қилиш усуллари,атроф-муҳитнинг ифлосланиши,Газ-кимё мажмуаларининг экологияга яъни озон қатламига таъсири, экологик муаммоларни бартараф қилишнинг йўллари,Чиқиндиларни тўғри йўналишларга йўналтириш(синтезлаш ёки қайта ишлаш).

Калит сўзлар: экология,енергия,радиатсия,олтингугурт оксидлари, озон қатлами,газ-кимё мажмуалари,чиқиндилар,сулфат кислота,

Ҳозирги вақтда умумбашарий глобал миқёслардаги кўп жабҳали оъзаро муносабатлар билан боғлик боъльган атроф-муҳит муаммолари муҳим оърин тутади. Бу муаммолар инсоннинг ҳаёт фаолиятини табиий ресурслар ва уларни қайта ишлаб ҳосил қиладиган маҳсулотлари билан таъминлашдаги мураккабликларга бевосита боғлиқ боъльган хомашё, энергия, озиқ-овқат, енгил саноат, дунё океан муаммоларидир.

Атмосферада корбанат ангидрид газининг тоъпланиши, газ саноати корхоналаридан чиқаётган CO2 (олтингугурт-IV оксиди) гази, радиатсия фонининг ортиб бориши, озон қатламидаги оъзгаришлар, минерал хомашёларнинг камайиши, яшил оъсимликлар қопламига эга боъльган майдонларнинг кескин камайиб бораётганлиги, атроф муҳитнинг ифлосланиши каби глобал оъзгаришларнинг содир боълиши билан боғлиқ боъльган ҳолда экологик муаммоларнинг тадқиқ қилишнинг аҳамияти ҳам тобора ортиб бормоқда. Зеро, "Ҳозирги пайтда экологик муаммолар миллий ва минтақавий доирадан чиқиб бутун инсониятнинг умумий муаммосига" айланган. Инсонлар техника тараққиётининг салбий оқибатларини бартараф қилиш билан боғлиқ боъльган муаммолар жумласига атроф муҳитни ишлаб чиқариш тармоқларининг яъни енгил ва оғир саноат корхоналари шу жумладан газ кимё мажмуаларнинг олтингугурт олиш сехларида олтингугурт IV-оксидини зарарли чиқиндилари билан ифлосланишидан муҳофаза қилиш ҳам диққатга сазовордир. Атроф муҳитни муҳофаза қилиш нафақат

оъта муҳим, ижтимоий вазифа боълиб қолмасдан айни пайтда у ишлаб чиқариш самарадорлигини оширишнинг жиддий омили ҳамдир.

Кам миқдордаги чиқиндиларни йоъқотишни ҳамда тутовчи газларни қоъшимча тозалашни ҳисобга олган ҳолда махсус тайёргарликлар ишлаб чиқилмоқда. Кимё саноатида, қишлоқ, хоъжалигида энг- кўп фойдаланиладиган махсулотлардан бири сулфат кислота олишга контакт усули энг катта аҳамиятга эга. Бу усул билан исталган консентратсиясидаги Ҳ2С04 ни, шунингдек олеум маҳсулотини, С03 нинг Ҳ2С04 даги эритмасини олиш мумкин. Айниқса олтингугуртдан хомашё сифатида фойдаланилганда олтингугурт (IV)-оксид ва сулфат кислота буғлари боълган газ қолдиқлари бир мунча хавфли ҳамдир. Газни қайта ишлаш заводлари, газ конлари бошқармалари ва газ кимё мажмуаларининг олтингугурт олиш сехларидан атмосферага чиқариб юборилаётган олтингугурт (IV) оксиди (С02) гази сулфат кислотасини контакт усулида олиш жараёнининг 1-босқич маҳсулоти ва ИИ-босқич хомашёси сифатида қоълланиши мумкин. Бизга маълумки, газ-кимё саноатида ишлаб чиқарилган элементлар олтингугуртнинг қарийб 90% кимёвий корхоналарда сулфат кислотасини ишлаб чиқаришга сарфланади яъни

С+02=С02 2 С02+02=2 С03 С03+Н20=Н2С04

реаксиялари боъйича сулфат кислота олинар эди.

Бизнинг лойиҳамизга кура III босқичда бажариладиган жараён II босқичда бажарилади. Тайёр ҳолдаги С02 ни оксидлаб С03 га айлантириш ва С03 ёки Н2С04 ни олиш коъзда тутилган, яъни

2 С02+02=2 С03 С02+Н20=Н2С04

реаксиялари бўйича сулфат кислота олиш мумкин.

Бу технологияни қоъллашдан мақсад, экологик муаммоларни ҳал қилишда атроф муҳит олтингугурт (IV) оксид (С02) газидан тозаланади ва кимёвий технология асосида ишлаётган корхоналар учун ноёб боълган сулфат кислотаси ишлаб чиқиш маҳаллий хомашёлардан олиниши коъзда тутилиб, коъплаб иқтисодий ва экологик самара бериши яққол сезилади . Биз табиатга қандай муносабатда бўлсак табиат бизга шундай

муносабатда бўлади. Биз турли хил атмосферага кўп миқдорда зарар етказадиган завод,фабрикаларни кўпайтирсак бу экологияга ва аҳоли саломатлигига ҳам зарар етказади. Агар биз жаҳон мамлакатлари биргаликда атроф муҳитни асраб-авайласак,ертанги кунимизга,халқимизга уларнинг саломатлигини асрашга ҳисса қўшган бўламиз. Агар ҳамма мамлакатлар бирлашсак катта куч бўламиз. Табиатни бирга қутқарамиз!

ФОЙДАЛАНИЛГАН АДАБИЁТЛАР

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ОБОБЩЕНИЕ РЯДА ФУРЬЕ ПРИ РЕШЕНИИ ИНТЕГРАЛА ТРИГОНОМЕТРИЧЕСКИХ ФУНКЦИЙ.

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Аннотация: Цель данной статьи является в том чтобы выявить сущность применения ряда Фурье при решении интеграла тригонометрических функций. Разработать критерии и сформировать в читателе понятия об этом ряде которые позволяли бы естественным образом овладеть некоторыми знаниями решения примеров при помощи ряда Фурье при решении интеграла тригонометрических функций.

Аннотация: Мазкур мақоланинг мақсади шундан иборатки, тригонометрик функцияларнинг интегралларини топишда Фурье қаторларидан фойдаланиш. Баъзи бир тригонометрик интегралларни топишда Фурье қаторидан фойдаланиш ва унинг мезонларини ишлаб чиқариш ҳақида ўқувчида тушунчани шакллантириш.

Absrtact: The given article stands to identify the essence of the use of the Fourier row in solving the integral of trigonometric functions, to formulate criteria and to form a concept of this series to the reader that would permit him to naturally acquire certain knowledge of solving examples using the Fourier raw in solving the integral of trigonometric functions.

Ключевые слова: Ряд, Фурье, интеграл, тригонометрическая функция, действительные корни, период, производная, коэффициент.

Введение:

Жан Батист Жозеф Фурье - французский математик, член Парижской Академии Наук (1817).

Первые труды Фурье относятся к алгебре. Уже в лекциях 1796 он изложил теорему о числе действительных корней алгебраического уравнения, лежащих между данными границами (опубл. 1820), названную его именем; полное решение о числе действительных корней алгебраического уравнения было получено в 1829 Ж.Ш.Ф. Штурмом. В 1818 Фурье исследовал вопрос об условиях применимости разработанного Ньютоном метода численного решения уравнений, не зная об аналогичных результатах, полученных в 1768 французским математиком Ж.Р. Мурайлем. Итогом работ Фурье по численным методам решения уравнений является «Анализ определённых уравнений», изданный посмертно в 1831.

Ряды Фурье играют большую роль в математической физике, теории упругости, электротехнике и особенно их частный случай – тригонометрические ряды Фурье.

Тригонометрическим рядом называют ряд вида

$$\frac{a_0}{2} + a_1 \cos \omega x + b_1 \sin \omega x + a_2 \cos 2\omega x + b_2 \sin 2\omega x + \ldots +$$

$$+ a_n \cos n\omega x + b_n \sin n\omega x + \ldots$$

или, символической записи:

$$\frac{a_0}{2}+\sum_{n=1}^{\infty}\left(a_n\cos n\omega x+b_n\sin n\omega x\right), \quad (1)$$

где ω, a_0, a_1, …, a_n, …, b_0, b_1, …,b_n, …- постоянные числа (ω>0) .

К изучению таких рядов исторически привели некоторые задачи физики, например задача о колебаниях струны (XVIII в.), задача о закономерностях в явлениях теплопроводности и др. В приложениях рассмотрение тригонометрических рядов, прежде всего связано с задачей представления данного движения, описанного уравнением y = ƒ(χ), в виде суммы простейших гармонических колебаний, часто взятых в бесконечно большом числе, т.е. в качестве суммы ряда вида (1).

Таким образом, мы приходим к следующей задаче: выяснить существует ли для данной функции ƒ(x) на заданном промежутке такой ряд (1), который сходился бы на этом промежутке к данной функции. Если это возможно, то говорят, что на этом промежутке функция ƒ(x) разлагается в тригонометрический ряд. Ряд (1) сходится в некоторой точке x_0, в силу периодичности функций $a_n\cos n\omega x+b_n\sin n\omega x$ (n=1,2,..), он окажется сходящимся и во всех точках вида $x_0+\frac{2\pi}{\omega}m$ (m- любое целое число), и тем самым его сумма S(x) будет (в области сходимости ряда) периодической функцией: если $S_n(x)$ – n-я частичная сумма этого ряда, то имеем

$$S_n\left(x_0+T\right)=S_n\left(x_0+\frac{2\pi}{\omega}\right)=S_n\left(x_0\right)$$

, где $T=\frac{2\pi}{\omega}$, а потому и $\lim\limits_{n\to+\infty}S_n(x_0+T)=\lim\limits_{n\to+\infty}S_n(x_0)$, т.е. $S(x_0+T) = S(x_0)$. Поэтому, говоря о разложении некоторой функции ƒ(x) в ряд вида (1), будем предполагать ƒ(x) периодической функцией.

Определение коэффициентов ряда по формулам Фурье

Пусть периодическая функция ƒ(x) с периодом 2π такая, что она представляется тригонометрическим рядом, сходящимся к данной функции в интервале (-π, π), т. е. является суммой этого ряда:

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}\left(a_n\cos nx+b_n\sin nx\right) \quad (2)$$

Предположим, что интеграл от функции, стоящей в левой части этого равенства, равняется сумме интегралов от членов этого ряда. Это будет выполняться, если предположить, что числовой ряд, составленный из коэффициентов данного тригонометрического ряда, абсолютно сходится, т.е.. сходится положительный числовой ряд

$$\left|\frac{a_0}{2}\right|+|a_1|+|b_1|+|a_2|+|b_2|+\ldots+|a_n|+|b_n|+\ldots \quad (3)$$

Ряд (1) мажорируем и его можно почленно интегрировать в промежутке (-π, π). Проинтегрируем обе части равенства (2):

$$\int_{-\pi}^{\pi} f(x)dx = \int_{-\pi}^{\pi} \frac{a_0}{2} + \sum_{n=1}^{\infty} \left(\int_{-\pi}^{\pi} a_n \cos nxdx + \int_{-\pi}^{\pi} b_n \sin nxdx \right)$$

Вычислим отдельно каждый интеграл, встречающийся в правой части:

$$\int_{-\pi}^{\pi} \frac{a_0}{2} dx = \pi a_0$$

,

$$\int_{-\pi}^{\pi} a_n \cos nxdx = a_n \int_{-\pi}^{\pi} \cos nxdx = \frac{a_n \sin nx}{n} \Bigg|_{-\pi}^{\pi} = 0$$

,

$$\int_{-\pi}^{\pi} b_n \sin nxdx = b_b \int_{-\pi}^{\pi} \sin nxdx = -\frac{b_n \cos nx}{n} \Bigg|_{-\pi}^{\pi} = 0$$

Таким образом, $\int_{-\pi}^{\pi} f(x)dx = \pi a_0$, откуда $a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x)dx$. (4)

Теорема 1. Пусть функция ƒ(x) периода 2π имеет непрерывную производную $f^{(s)}(x)$ порядка s, удовлетворяющей на всей действительной оси неравенству:

$| f^{(s)}(x) | \le M_s$; (1')

тогда коэффициенты Фурье функции ƒ удовлетворяют неравенству

$$|a_k| \le \frac{2M_s}{k^s}, \quad |b_k| \le \frac{2M_s}{k^s} \qquad (k = 1,2,\ldots) \qquad (2')$$

Доказательство. Интегрируя по частям и учитывая, что ƒ(-π) = ƒ(π), имеем

$$a_k = \frac{1}{\pi} \int_{-\pi}^{\pi} f(t)\cos ktdt = \frac{1}{\pi} \left[f(t) \frac{\sin kt}{k} \Bigg|_{-\pi}^{\pi} - \int_{-\pi}^{\pi} f'(t) \frac{\sin kt}{k} dt \right] =$$

$$= -\frac{1}{\pi k} \int_{-\pi}^{\pi} f'(t) \sin ktdt. \qquad (3')$$

Поэтому

$$|a_k| \le \frac{1}{\pi k} \int_{-\pi}^{\pi} M_1 \cdot 1dx = \frac{2M_1}{k} \cdot$$

Интегрируя правую часть (3') последовательно, учитывая, что производные ƒ', ..., $f^{(s-1)}$ непрерывны и принимают одинаковые значения в точках t = -π и t = π, а также оценку (1'), получим первую оценку (2').

Вторая оценка (2') получается подобным образом.

Теорема 2. Для коэффициентов Фурье ƒ(x) имеет место неравенство

$$\{|a_k|,|b_k|\} \le \frac{1}{2\pi}\int_{-\pi}^{\pi}\left|f(t+\frac{\pi}{k})-f(t)\right|dt. \qquad (4')$$

Доказательство. Имеем

$$a_k = \frac{1}{\pi}\int_{-\pi}^{\pi} f(t)\cos ktdt. \qquad (5')$$

Вводя в данном случае замену переменной $t = u + \frac{\pi}{k}$ и учитывая, что ƒ(x) – периодическая функция, получим

$$a_k = \frac{1}{\pi}\int_{-\pi+\frac{\pi}{k}}^{\pi+\frac{\pi}{k}} f(u+\frac{\pi}{k})\cos(ku+\pi)du =$$

$$= -\frac{1}{\pi}\int_{-\pi}^{\pi} f(u+\frac{\pi}{k})\cos ku)du. \qquad (6')$$

Складывая (5’) и (6’), получаем

$$a_k = -\frac{1}{2\pi}\int_{-\pi}^{\pi}\left[f(u+\frac{\pi}{k})-f(u)\right]\cos kudu.$$

Отсюда

$$|a_k| \le \frac{1}{2\pi}\int_{-\pi}^{\pi}\left|f(u+\frac{\pi}{k})-f(u)\right|du.$$

Аналогичным образом проводим доказательство для b_k.

Следствие. Если функция ƒ(x) непрерывна, то её коэффициенты Фурье стремятся к нулю: $a_k \to 0$, $b_k \to 0$, $k \to \infty$.

Интегралы от периодических функций

Пусть ƒ(x) – периодическая функция, с периодом T, интегрируемая на любом сегменте вида $[x_0, x_0+T]$.

Тогда величина интеграла $\int_{x_0}^{x_0+T} f(x)dx$ остаётся при любом x_0 одной и той же: для любых x_0, x_0'

$$\int_{x}^{x_0+T} f(x)dx = \int_{x_0}^{x_0+T} f(x)dx$$

.

1.3 Интегралы от некоторых тригонометрических функций

Укажем значения некоторых интегралов:

$$\int_{-\pi}^{\pi} \cos kxdx = \int_{-\pi}^{\pi} \sin kxdx = 0$$ (k = 1,2,...), (5)

$$\int_{-\pi}^{\pi} \cos kx \sin mxdx = 0$$ (k =1,2,..; m =1,2,...), (6)

$$\int_{-\pi}^{\pi} \cos kx \cos mxdx = \int_{-\pi}^{\pi} \sin kx \sin mxdx = 0$$ (7)

(k =1,2,...; m =1,2,...; k ≠ m),

$$\int_{-\pi}^{\pi} \cos^2 kxdx = \int_{-\pi}^{\pi} \sin^2 kxdx = \pi$$ (k =1,2,...) (8)

Теперь можем вычислить коэффициенты Фурье a_k и b_k ряда (2). Для разыскания коэффициента a_n при каком-либо определенном значении n≠0 умножим обе части равенства (2) на cosnx и произведя математические операции в пределах от –π до π, получим:

$$a_k = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos kxdx$$ (9)

$$b_k = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin kxdx$$ (10)

Коэффициенты, определенные по формулам (4), (9), (10) называются коэффициентами Фурье функции ƒ(x), а составленный тригонометрический ряд (10) с такими коэффициентами называется рядом Фурье функции ƒ(x).

В некоторых случаях, для более узких классов функций, формулы (9), (10) были известны ещё Эйлеру. Таким образом, эти формулы ещё называют формулами Эйлера-Фурье.

Заключение

В этой работе приведена лишь малая часть примеров и формул того как ряды Фурье позволяют решить важные задачи в математическом анализе. На этом небольшом количестве страниц изложен материал, содержащий основные теории рядов Фурье. Работа начинается с представления о ряде Фурье. Рассмотрены примеры применений преобразований Фурье и метода Фурье (метода разделения переменных).

Так как теория тригонометрических рядов (рядов Фурье) в настоящее время достаточно велика по своему содержанию и объему, то естественно, что здесь не мог быть исчерпан весь материал.

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“MEXANIKA” BO’LIMINI O’QITISHDA INTERFAOL METODLARDAN FOYDALANISHNING O’ZIGA XOS XUSUSIYATLARI

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Annotasiya: Ushbu maqolada fizika fanining mexanika bo’limini interfaol usullardan samarali foydalanish va mavzularga mos hayotiy misollar keltirish orqali ta’lim sifatini, o’quvchilarning faolligini, qiziqishini orttirishdagi afzalliklari, samaradorligi haqida so’z borgan.

Kalit so’zlar: “Mexanika” bo’limida qo’llash mumkin bo’lgan metodlar, “Topishmoq” usuli, kinamatikaga doir masala ishlash namunasi

Umumiy o’rta ta’lim muassasalarida o’quvchilarga fizika fanining fundamental bilimi mexanika bo’limi orqali berilib boriladi. Shu sababli bu bo’limdan boshlab o’quvchilarni fanga qiziqtirish, boshlang’ich bilim, ko’nikmalarini shakllantirish pedagoglarga ikki karra ma’sulyat yuklaydi. Mexaniki bo’limi eramizdan oldingi III asrdan boshlab paydo bo’lgan va uning asoschisi sifatida Arximed ni bilamiz. Mexanika - bo’limi moddiy nuqta harakatining eng sodda va umumiy fo’rmulalarini o’rganadi. U jismlarning yoki jism bo’laklarining bir-biriga taqqoslagandagi harakatini aniqlovchi mexanik harakat haqidagi ta’lim turidir. Kinamatika, Dinamika, Statika mexanika bo’limining asosiy boblaridir. Ularning asosida moddiy jismlarning modeli va moddiy nuqta va fazoda uzluksiz bo’lishtirilgan nuqtalar sistemasi, ularning tekis traektoriyalarda o’z aro ta’siri natijasidagi uzluksiz harakati kiradi. Hozirgi kundagi zamonaviy ta’limning maqsadi ortiqcha ruhiy va jismoniy kuch sarf etmagan holda, qisqa vaqt davomida samarali natijalarga erishishdir. Darsga ajratilgan qisqa vaqt davomida muayyan nazariy bilimlarini o’quvchilarga yetkazib berish va ushbu bilimni mustahkamlab amaliyotda qo’llashni o’rgatish, shuningdek o’quvchilar faoliyati, bilimini nazorat qilish, ularning bilim ko’nikma va malakalarini baholashdir. Ushbu maqsadga biz AKT, multimedion texnologiyalar, ko’rgazmali qurollar va albatta mavzuga mos interfaol usullarni qo’llash orqali erishishimiz mumkin.

Ta’lim tizimida interfaol usullarning mohiyati va ko’rinishi kundan-kunga ortib, o’zgarib bormoqda. Mohir pedagog esa bu usullardan dars jarayonida unumli foydalana olishi ya’ni fizika fanining mavzularini, o’quvchilarning yosh chegarasini, o’zlashtirishini, inobatga olgan holda metod qo’llay olishi, o’quvchilarning qiziqishi va o’zlashtirish ko’rsatkichining ortishiga sabab bo’ladi. **Quyida 7-sinf mexanika bo’limiga qo’llash mumkun bo’lgan interfaol usullarning to’liq bo’lmagan ro’yxati:**

“Klaster”, “Krassword”, “BBB”, “Aqliy hujim”, “Venn diagramasi”, “Zig-zak”, “Suhbat”, “Topishmoq”, “Keling tanishamiz” va boshqalar.

Mexanika bo’limini o’rgatishda, 13-14 yoshdagi (7-sinfdagi) o’quvchilarining ruhiy, psixologik holatini hisobga olib murakkab bo’lmagan sodda, qiziqarli usullardan foydalanish maqsadga muvofiq.

Ulardan biri sifatida “Topishmoq” usulini misol keltirishimiz mumkin:

Tiq-tiq etib doimo
Uzoq vaqtlar tinmaydi,
Charchadim deb aytmas hech

Sira bir dam olmaydi. Javob: (soat)

Yozda toycha, qishda xurjun. Javob: (velosiped)

O'quvchilarga topishmoq usulini qo'llaganimizda ularning o'zlashtirish darajasi, topqirligi, fikrlash doirasi, chaqqonligi sinoqdan o'tadi shu bilan birga ularni izlanishga undaydi. Topishmoqlar tabiat va jismlarni bilish, sezish, kuzatish, solishtirish, xotirani mustahkamlash kabi reflekslarni rivojlantirishga yordam beradi. Shu bilan birga tabiat go'zzaligi va sirini anglashga undaydi.

Kinematika bo'limiga tegishli tezlik, vaqt, yo'l haqidagi tushunchalarga oid masalar ishlaganimizda "Suhbat"usulidan foydalanishimiz mumkun. Bunda o'qtuvchi o'quvchilardan biriga uyidan maktabgacha qancha daqiqada kelishini so'raydi va buni (t) harfi bilan belgilaydi, maktab va uy orasida qancha masofa borligini so'rab (s) harfi bilan belgilab, doskaga jadval ko'rinishida yozadi. Ya'ni

Maktabdan uygacha masofa s=900metr

Shu masofani bosib o'tish uchun ketgan vaqt t=10minut

Topish kerak; ϑ-?

Berilgani:	Formulasi:	Yechilishi:
s-900metr t-5miut=300sekund ϑ-?	$\vartheta = \frac{s}{t}$	$\vartheta = \frac{900}{300}$= 3m\s

Ta'lim oluvchilarning jism tezligi haqida tushunchasi yanada ortishi, masala mohiyatini tushuntirish uchun o'quvchilarga sportchilar yugurgandagi tezligi 5m\s, velosipedning tezligi 10m\s, avtomobilning tezligi 25m\s haqida ma'lumot berib o'tish ularda solishtirish, kuzatish qobilyatlarini rivojlantirib, o'zlashtirish ko'rsatkichi oshadi.

Xulosa o'rnida shuni aytish joizki maxanika bo'limini o'qitishda o'quvchilarga nazariy bilimlarini, masala ishlashni, laboratoriya mashg'ulotlarini tashkil etishda interfaol usullardan foydalanish fizika fani bo'limlari bilan endi tanishib kelayotgan yosh ta'lim oluvchini qiziqishi ortishiga, ta'lim sifatining oshishiga sabab bo'ladi.

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FIZIKA FANINI O'QITISHDA FSMU USULIDAN FOYDALANISH AFZALLIKLARI

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Annotatsiya: Maqolada fizika fanini FSMU usulidan samarali foydalanish orqali ta'lim sifatini, o'quvchilarning faolligini, qiziqishini orttirishdagi afzalliklari, samaradorligi haqida so'z borgan.

Kalit so'zlar: FSMU usuli

Umumiy o'rta ta'lim muassasalarida ta'lim sifatini oshirishda zamonaviy pedagogik texnologiyalarning, interfaol metodlarning o'rni muhim ahamiyatga ega. Interfaol metodlar-ta'lim oluvchi shaxsiga yo'naltirilgan, demokratik hamda takrorlanuvchan o'qish natijalarini kafolatlaydigan ta'lim jarayonlarini loyihalash, amalga oshirish va baholashning tizimiy metodidir. Uning an'anaviy usulidan farqi, u o'quvchilarning o'zlariga berilgan bilimni yodlab aytib berishga emas, balki ta'lim-tarbiya jarayonining yakunida konkret bir harakatlarni bajarishga yo'naltirilganligidadir. Fizika darslarini tashkil etishda interfaol metodlardan foydalanish ta'lim sifatining oshishiga xizmat qiladi. Bunday metodlardan biri FSMU usuli hisoblanadi.

FSMU usuliga tavsif: Bu usulni fizika fanidan yangi mavzuni mustahkamlashda qo'llashimiz mumkun. Bunda o'rganilayotgan mavzuning muhokamasiga tegishli masalalar bo'yicha o'quvchilarning o'z fikr-mulohazalarini bayon qilishlari, shu fikrni asoslovchi sabab ko'rsatishlari va isbotlash maqsadida misollar keltirishlari va barchasini umumlashtiruvchi xulosa chiqarishlari mumkun bo'lgan usuldir. Bunda o'quvchilarning erkin fikrlashi, shaxsiy fikrini himoya qilishi va isbotlashi shu bilan bir qatorda nazariy bilimlarini tahlil etishga, o'zlashtirish darajasini, fikrlash doirasini, dunyoqarashini aniqlashga va baholashga imkoniyat yaratadi. Quyida metod sxemasi ketirilgan.

F-fikringizni bayon eting;

S-fikringizni asoslavchi sabab ko'rsating;

M-fikringizni isbotlovchi misol keltiring;

U-Fikringizni umumlashtiring;

Ushbu metodni sinfda kichik guruhlarga bo'lib yoki yakka tartibda qo'llash mumkun.

Masalan: Nima uchun odamlar yerda (planetamizda) erkin harakat qiladi? Lekin fazoda muvozanatni yo'qotadilar?

F- yerda odamlar og'irlik kuchi sababidan erkin harakatlanadi, fazoda esa bu kuch nisbatan kam bo'lganligi uchun muvozanatni yo'qotadilar. Og'irlik kuchinig formulasi esa P=mg

S -og'irlik kuchi qancha yuqori bo'lsa muvozanatni saqlash shunchalar oson. Jism massasi yerda va fazoda o'zgarmasligini hisoblasak bu yerda o'zgaruvchan birlik g yani erkin tushish tezlanish. G esa og'irlik kuchiga to'g'ri proportsinal g qancha yuqori bo'lsa og'irlik kuchi shuncha katta bo'ladi, g qancha kam bo'lsa og'irlik kuchi shuncha kam.

M- masalan yerda tortishish kuchi g=9,8m\s; oyda tortishish kuchi g=1,6m\s, marsda esa g=3,69m\s

Bu degani yerdagi 50kg massali odam p=mg bo'lganligi sababli og'irlik kuchi 500N, oyda esa 160N, marsda 36,9N tashkil etadi.

U- Jism muvozanatda bo'lishi asosan og'irlik kuchi ya'ni jism massasi, erkin tushish tezlanishiga bog'liq bo'lganligi sababli bu ikki parametrning ifoda o'zgarishi og'irlik kuchining o'zgarishiga sabab bo'ladi. Erkin tushish tezlanish esa muhitga bog'liq o'zgaradi.

Xulosa o'rnida shuni aytish mumkinki FSMU usulini fizika darsida qo'llash ta'lim sifatining oshishiga, o'quvchilarning fikrlash doirasi, dunyoqarashi rivojlanishiga, erkin fikrlash, fikrini ifodalash va uni himoya qilishga o'rgatadi. Bu esa hozirgi kundagi asosiy maqsadimiz va vazifamiz hisoblanadi.

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